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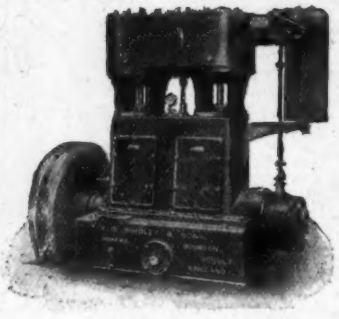

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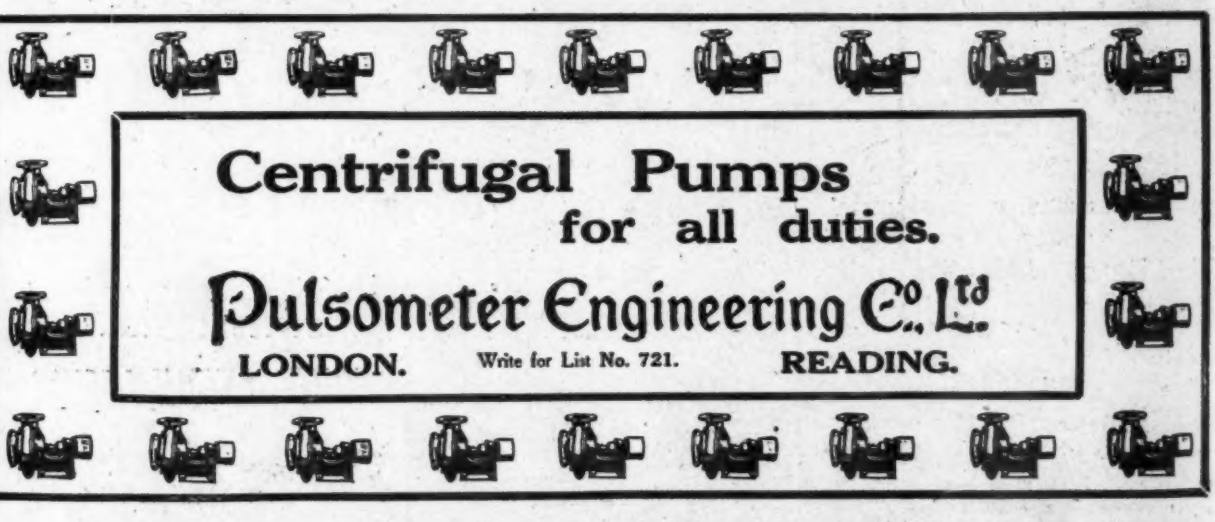

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THE

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INDUSTRIAL RESEARCH.

THE second annual report of the Committee of the Privy Council for Scientific and Industrial Research (the first part of which is abstracted elsewhere in this issue) is characterised by a practical spirit which augurs well for the success of its important undertakings. The Committee has a very difficult task to accomplish, and is cultivating ground which has hitherto remained almost unbroken; in order to reap a satisfactory harvest within a reasonable period many weeds will have to be uprooted—the jealousies of rival firms, the bonds of traditional secretiveness, the inertia of old-established firms, the inefficiency or total absence of organisation in certain trades, and other adverse influences; but by avoiding the attempt to establish rigid lines of procedure, and by showing a disposition to treat every question that arises, on its own merits, the Committee has retained an elasticity of administration which immensely facilitates the progress of its work, and affords good grounds for confidence in the ultimate success of its endeavours. Quite typical of this elasticity is the decision of the Government to allocate a sum of one million sterling for expenditure spread over a period of five years, instead of an annual subsidy which must not be exceeded, while any balance that remained, being reabsorbed into the State funds, would not have been available to augment the allowance in the following year. Thus the hands of the new Department are set free to cope with any conditions that may arise, and to provide for initial outlay on a generous scale, such as is likely to be found essential to the rapid promotion of important researches. One million pounds would not suffice to build a single battleship; but in the light of past experience, of the rich returns already derived from the meagre allowances doled out to the National Physical Laboratory in pre-war times, and of magnificent results accruing from the outlay on researches in connection with optical glass, dye-stuffs, and other war-time necessities, there is no room for doubt that the expenditure of this modest capital will not only provide its own justification, but will quickly lead to the devotion of vastly greater sums to this most profitable service.

Another welcome trait which marks the Committee's proceedings is the readiness which it manifests to take its own medicine, and to co-operate cordially with any and every Government Department or public body whose aims are in harmony with its own, or whose specialised knowledge can be utilised to the national advantage. It is, to our mind, of the utmost importance that the wealth of

knowledge and experience which is represented by our great scientific and technical societies should be drawn upon most freely, and that their advice should be sought and duly weighed before any important action is taken by the Government in industrial affairs. This course has not been followed in the past; the officials whose influence in Government Departments is paramount have usually, whether intentionally or in blank ignorance, refrained from consulting such bodies, with the natural result that their decisions have often done more harm than good to the industries they professed to help. Our Government is, in fact, far more bureaucratic and reactionary than the public generally are aware, and this is largely, if not entirely, owing to the narrow classical curriculum of the public schools, in which history, geography, and science are practically ignored.

While the exceedingly valuable results already obtained in various applications derive their origin mainly from independent researches that were set on foot by the Government, with the assistance of the Board of Scientific Societies, soon after the outbreak of war, and by our scientific and industrial associations, long before the Committee was appointed to organise research, they are of the same order as those which may be expected to accrue from the efforts of the Department, which, moreover, has taken steps to ensure their continuance, and to extend their scope. The Committee does not pretend that the nation "will reap the fruits of these preparatory labours" until after the return of peace. Nevertheless, good results are beginning to flow in from the new work put in hand by the Committee, which is methodically laying a sure and solid foundation for the development of industrial research. Unfortunately, owing to the exigencies of the time, the Committee has found it impossible to devote attention to the subject of research in pure science, but it recognises that this is the seed with which the industrial field is sown, and that to neglect it would be a fatuous error. We must see to it that the Committee shall not fail to discharge its duty to pure science at the earliest possible moment—otherwise its labours will prove futile.

Lastly, we commend the attitude of the Department towards the rights of the inventor, whom it appears determined to encourage and support. Invention has too often been the mother of necessity, and the poor inventor in particular ought to be protected and assisted.

Our Commercial Intelligence Service.

In our last issue, in referring to the decision to appoint additional Trade Commissioners, we mentioned that the Cabinet had given its approval to the scheme for reorganising the Commercial Intelligence Service of the country by bringing the operations of the Foreign Office and of the Board of Trade in this connection under unified control. The full details of this scheme are now published in the form of a Memorandum, which was reprinted in the *Times* on August 31st. As would be expected, difficulties were encountered when those responsible for dealing with the matter tried to define and adjust the limits of responsibility of the Foreign Office and the Board of Trade with respect to the collection and distribution of commercial intelligence obtained through the medium of the Commercial Attachés and Consuls in foreign countries. A Committee which, in addition to eminent men from the two Departments, included Lord Faringdon, Mr. Dudley Docker (Federation of British Industries), and Mr. Pennefather, M.P., representing the Chambers of Commerce, sat to try to solve the difficulties, but these gentlemen were not able to arrive at a unanimous agreement. They agreed that the control of the Commercial Attachés should be left to the Foreign Office, acting in consultation with the Board of Trade as regards instructions and appointments, and that both this service and the Consular Service should be enlarged and improved. Another Committee has been appointed to carry these recommendations into effect with the least possible delay. Where the Committee could not agree was on the question of whether the work of collating and distributing commercial intelligence from foreign countries among the commercial community in this country should continue to be performed by the Department of Commercial Intelligence of the Board of Trade or should be dealt with by a Department to be created at the Foreign Office. The majority of the Committee favoured the work being done by the Foreign Office. The two Departments, therefore, considered the matter further, and arrived at a scheme, which has been approved by the War Cabinet, and is set forth in detail in the Memorandum from which we quote below:—

An enlarged Commercial Intelligence Department will be created on a scale adequate to meet the reasonable requirements of British trade after the war. Parliamentary control over the Department will be exercised through a new Parliamentary Secretary, who will occupy the position both of Additional Parliamentary Secretary at the Board of Trade, and also Additional Parliamentary Under-Secretary for Foreign Affairs. This Parliamentary Secretary will be responsible to the President of the Board of Trade for all matters within the competence of that Department, and responsible to the Secretary of State for Foreign Affairs for all matters concerning the Foreign Office. By matters concerning the Foreign Office is meant all questions concerning the direction and organisation of the Commercial Attaché and Consular Services and the commercial work of officers of these services, and of the Diplomatic Service, so far as these matters are not dealt with by the Consular or other Departments of the Foreign Office, and also matters concerning the *personnel* of the Foreign Office and of the above services who may be temporarily attached to the Department, and any matters arising out of the work of the Department involving questions of foreign policy. All instructions issued to Commercial Attachés or other Diplomatic or Consular Officers will be issued in the name of the Secretary of State for Foreign Affairs. On all other matters the responsibility will lie with the Board of Trade. The Commercial Intelligence Department will eventually comprise the existing Department of Commercial Intelligence of the Board of Trade and the Foreign Trade Department of the Foreign Office, and will take over such of the staff and records of the War Trade Intelligence and Statistical Departments as may be available and required.

The official head of the Department will be an officer appointed jointly by the President of the Board of Trade and the Secretary of State for Foreign Affairs, working under the new Parliamentary Secretary. The appointment and control of the Trade Commissioners within the Empire will, as at present, rest with the Board of Trade, and the appointment and control of the Commercial Attachés and Consular Service with the Foreign Office, but the work of the new Department will comprise all matters dealing with commercial intelligence, and, so far as is necessary for that purpose, it will give directions to the oversea services and make the necessary arrangements for keeping them in close touch with the commercial classes in this country.

There will be a constant interchange of staff between the Department and both the Foreign Office and the Board of Trade, so that members of those Departments may be thoroughly acquainted with the work. The Department will be assisted by an Advisory Committee of business men.

Duality of control is one of the great errors that has been developed in connection with such matters in the past, and the foregoing represents a serious effort to devise means for getting rid of it. The end sought by those who have devoted so much anxious thought to the scheme is to secure that the direction of the commercial work of the foreign services and the distribution of commercial intelligence collected by them shall be under a single Department, which shall also direct the activities of the enlarged Trade Commissioner service. It is anticipated that by so doing there will be assured a uniformity of policy for our entire overseas trade.

THE MODERNISATION OF STUART STREET GENERATING STATION, MANCHESTER.

The history of the Stuart Street generating station will be found to synchronise very closely with the industrial electrical development of Manchester.

As in the case of other industrial centres, the local problem during recent years has been to keep pace with the increasing requirements of power users, with this difference, that the Manchester problem has all along been on a magnified scale, which, needless to add, has become increasingly difficult during the last three years.

In 1913 the electricity undertaking exceeded the 100 million mark in output sold, and during the year ended March last, over 172 millions of Board of Trade units were disposed of, a total which might easily have been 200 millions had all anticipations been realised.

The Stuart Street generating station, which dates back some 17 years, marked the decision to generate three-phase E.H.T. energy in place of the L.T. direct-current which had previously sufficed for local requirements; this latter supply was given from the original Dickinson Street station, supplemented in 1901 by the adjacent Bloom Street Station.

The Stuart Street station was constructed in two parts, the earlier portion to the design of Sir (then Dr.) Alexander Kennedy, while the second portion was originated by Mr. G. F. Metzger, city electrical engineer at that time, and reciprocating plant in comparatively large units was installed by both these engineers.* With the advent of Mr. S. L. Pearce, the present city electrical engineer and manager, the installation of reciprocating plant was discontinued, he having decided for various reasons to install turbine plant in future. We must refer our readers to the various articles which have appeared in our pages for details of the extensions which have been carried out from time to time; it will be sufficient to say that under Mr. Pearce's direction the reciprocating plant was supplemented by three turbo-alternators of 6,000, 6,000, and 7,500† KW. capacity respectively, followed by a 15,000-KW. machine,§ which was the first really large turbine set to be installed in this country. In addition to these high-pressure turbines, a 4,500-KW. exhaust steam turbine‖ and jet condensing plant was installed to operate on the exhausts from three of the six 2,500-H.P. Corliss engine sets which comprised the generating equipment of the first portion of Stuart Street station.

Contemporarily with these extensions, additions were made to the boiler and cooling tower installations, and prior to the outbreak of war it was agreed, in view of the limited condensing facilities and necessity of making adequate provision for coal storage, that some 60,000 KW. of installed plant capacity represented the economic limit of the Stuart Street site.

In view of this the Manchester authorities, on the advice of Mr. Pearce, decided to launch out a bold scheme for meeting the rapidly increasing electrical necessities of the area, and as a result, what would have been the first super-station in the Kingdom was planned, with a projected capacity of 160,000 KW.‡ A site was selected at Barton, about five miles from the centre of the city, all sanctions were obtained, and all preparations made for the actual construction of this station, but in view of the now well known difficulties as regards industrial developments which arose as a result of the concentration of the country's resources on the war, it was found necessary to postpone the carrying out of this project, and to concentrate attention on the Stuart Street station, which policy offered the only means of meeting the urgent demands for power arising from the war. This policy involved the supersession of the then existing reciprocating plant by turbine plant, and when the scheme of reconstruction now being carried out is completed, only one 6,000-H.P. reciprocating engine set will remain in the station.

Since the outbreak of war, two 6,000-KW. turbo-alternators, one of Westinghouse-Siemens and the other of Westinghouse construction, each running at 3,000 R.P.M., and operating in conjunction with Mirrlees-Watson jet condensers, have been installed in the place of two of the original 2,500-H.P. cross-compound vertical Corliss engine sets.

The 4,500-KW. Howden-Siemens exhaust steam turbine, which operated in conjunction with three other of the above engine units, has been reconstructed on high-pressure lines to use live steam, and this incidentally freed one half of the existing condensing plant for use with the additional turbines.

A second 15,000-KW. Richardson-Westgarth turbine coupled to a Westinghouse alternator, running at 1,500 R.P.M., is now being installed in place of one of the 6,000-H.P. (4,000-KW.) Wallsend-Electrical Co. sets; this is fitted with Richardson-Westgarth surface condensing plant.

There is also on order for delivery in the autumn of 1918 a 20,000-KW. turbo-alternator set, by the last-mentioned firm; it may be mentioned that both these large turbine sets are very conservatively rated, and would under Engineering Standards conditions be regarded as of 20,000 and 25,000 KW. maximum continuous rating respectively.

As previously mentioned, one of the difficulties of the Stuart Street site has always been water shortage; some of the condensing plant is, of course, jet condensing, the Manchester and Ashton-under-Lyne Canal furnishing the necessary water, but for the surface condensing plant, cooling towers and tank storage have been provided, and this latter installation will be greatly extended when the large contracts which have been entered into with the Klein and Davenport Companies for new natural and fan draught towers are completed.

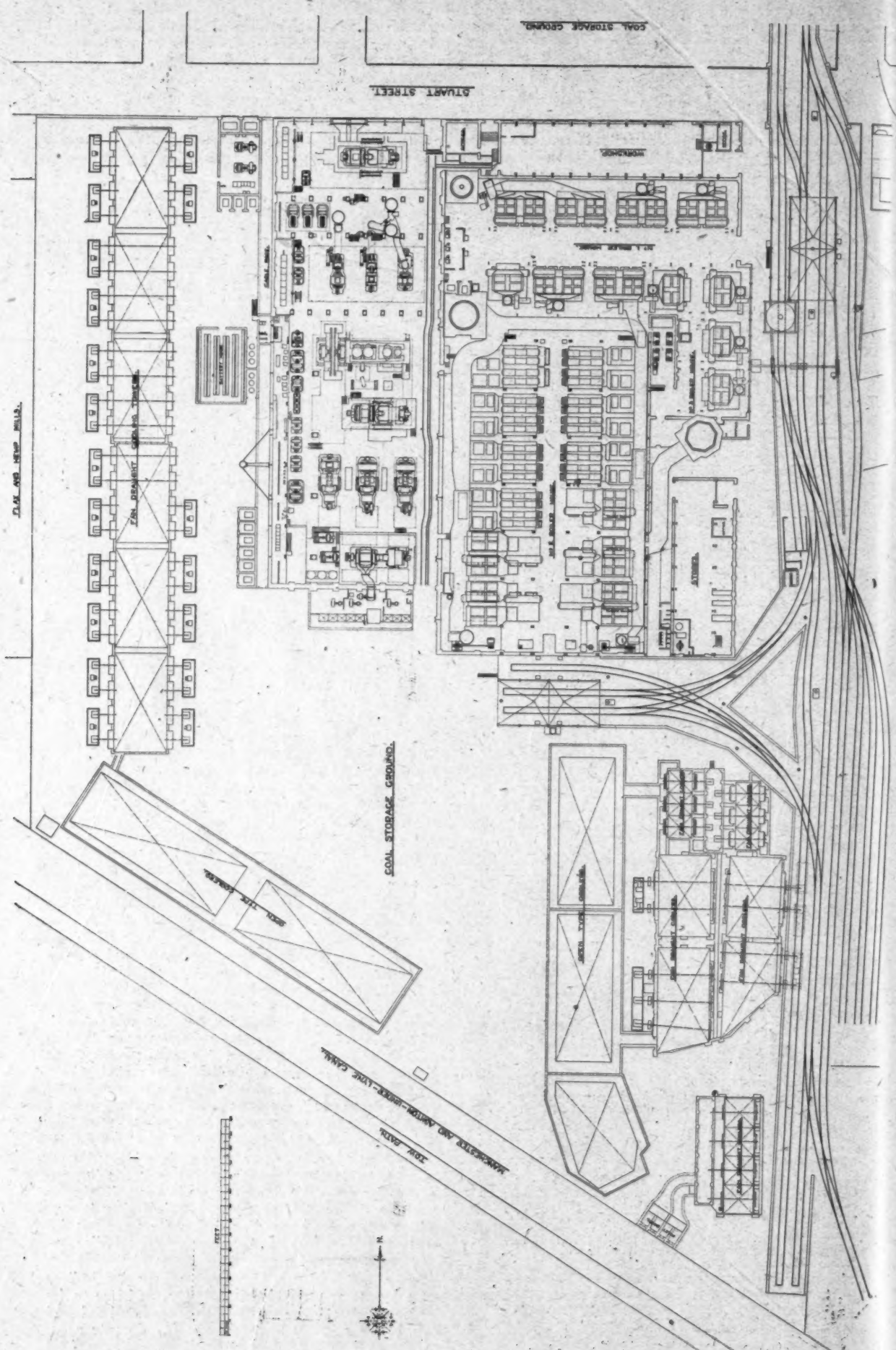
The disproportionate increase in generating capacity as compared with floor area, due to the large increase in turbine plant, naturally involved certain reconstruction in the steam raising installation to meet the increased demand for steam.

Prior to the war, the boiler plant comprised 46 boilers—of the Babcock & Wilcox land and marine types—installed in two boiler houses; a third boiler-house has now been added, in which two Babcock and Wilcox marine type boilers, each of 60,000 lb. per hour evaporative capacity, have been installed. These boilers are self-contained units, one having straight induced draught and the other the Prat ejector draught plant, while both have chain-grate stokers; they were originally intended for the projected Barton station.

The first boiler house, constructed under the Kennedy scheme, is being modernised, and its equipment of 24, 12,000-lb.-per-hour Babcock & Wilcox boilers is to be swept away; two new 60,000 lb.-per-hour boiler units, similar to those in the third boiler house, will shortly be in use in this boiler house, and orders have been placed for four 100,000 lb-per-hour Babcock & Wilcox marine type boilers as a further installation.

These are probably the largest capacity boilers so far contemplated in this country, and are to be single-ended and fitted with both forced and induced draught. Each will have 416 sq. ft. of grate area,

* Elec. Rev., June 26th, 1903.
† Elec. Rev., July 4th, 1913.
§ Elec. Rev., July 3rd, 1914.
‖ Elec. Rev., June 27th, 1913.
‡ Barton Power Scheme; Elec. Rev., January 8th, 1915.



Plan of Stuart Street Generating Station, Manchester, as Reconstructed with Turbine Plant, &c.

14,000 sq. ft. of heating surface, 7,500 sq. ft. of economiser surface, and 5,145 sq. ft. of superheater surface, and be constructed as a self-contained unit. Large boiler units are essential to secure the utmost development of the Stuart Street site, hence the drastic action in connection with the older plant.

To supply the increased coal requirements of the station, a third line of conveyors is being added in the first and second boiler houses, and in connection with these and other industrial developments in the neighbourhood, the coal railway facilities will be doubled, and in the result the cost of delivering fuel will be greatly reduced.

The large increase in plant capacity at Stuart Street has necessitated the remodelling of the E.H.T. switchgear, and large-capacity switches are being installed throughout, the bus-bars are being sectionalised with reactances, and a reactor house is being constructed to contain the latter.

In addition to this work, a turbine set is being installed in the Bloom Street station, to allow of which one of the four 1,800-KW. Musgrave-Westinghouse direct-current vertical Corliss engine sets has been removed.

The new plant is being supplied by the British Westinghouse Co., and will have a rating of 10,000 KW., speed of 1,500 R.P.M., and supply three-phase current into the E.H.T. system; its use will also enable the three remaining reciprocating sets to be shut down. It will further supply the local direct-current requirements for lighting and traction, through the converting plant, some 7,000 KW. of which is installed, in the adjoining Dickinson Street station, and be supplemented when necessary by the remaining direct-current generating plant in these stations.

As many of our readers are aware, the electrical development of the Manchester area has made rapid strides during the last 10 years, during which period its output has increased fourfold. Even with Stuart Street station remodelled, and containing between 90,000 KW. and 100,000 KW. of generating plant, and the additional plant at Bloom Street, the problem of meeting future requirements, by the construction of the Barton station, must still remain.

This problem has, however, been raised to a new plane since the wider aspects of electrical supply became emphasised, and we venture to prophesy that the *rôle* of the Barton power station, when it materialises, will be of a different character than was anticipated when the original proposal took shape. One need only point to the proposed establishment for manufacturing nitric acid from the air, which may ultimately require some 15,000 KW., the carbide factory which is being built and will take some 10,000 KW., and to the growing list of factories, including electric furnace and electric rolling mill equipments, to indicate that the future large scale requirements of this area are by no means visionary.

In conclusion, our thanks are due to Mr. S. L. Pearce, the chief engineer and manager of the Manchester electricity undertaking, for enabling us to briefly indicate the trend of events in the department under his control.

Plan of Stuart Street Generating Station, Manchester, as Reconstructed with Turbine Plant, &c.

Platinum.—A Reuter's correspondent at New York states that the discovery of platinum in Alaska has aroused Government agencies to the greatest activity in the hope of finding sufficient quantities of this metal to meet the war needs of the Allies. Four Government experts have been assigned to study the Alaskan situation and report if the discoveries may replenish the platinum supply cut off recently by the virtual cessation of activities in the Ural Mountain mines, the source of the world's greatest supply. So acute is the world shortage of platinum that the metal has advanced from $45 to $105 an ounce since the beginning of the war.

ELECTRIC VEHICLE NOTES.

The industrial possibilities of the electric truck and tractor in this country offer an exceedingly wide field for speculation; so far we have touched the fringe of the development in sight, and the as-yet unconsidered possibilities of this form of transport represent probably an equally large field of usefulness.

Apart altogether from private and municipal users of the industrial electric, probably the most hopeful sign of future progress is in the extensive purchases of these vehicles by great railway companies, whose interest in a new proposition is anything but experimental in character. If the railway companies prove to their own satisfaction that the movement of freight from their yards and warehouses can be more economically dealt with by electric than other types of vehicle, the time will not be far distant when our dock and harbour authorities, and the carrying companies connected with them, will begin to hold similar views.

Railway and dock premises in large cities are always costly matters, and a portion of this cost can, of course, be debited to the horse when making comparisons, inasmuch as goods yards, loading docks, and the sheds, which often cover the latter, have to be made proportionately larger to allow for the increased standing and manœuvring space required by the horse-drawn vehicles as compared with that needed by electric vehicles.

The handiness and adaptability of the "electric," and the ease with which it can be manœuvred, are of supreme importance where rapid handling of deliveries is essential, added to which is its freedom from fire risk, which often makes it the only type of motor vehicle which can be admitted into warehouses where combustibles are stored. The horse vehicle is a luxury in the case of a large transport organisation, and one for which not only does it pay, but the surrounding community also, through congestion of traffic in the streets, loss of time, &c.

A typical example of what may come in this country is shown by the practice of the Brush Terminal Co., of New York, whose premises cover some 200 acres along a mile of water front, and include eight piers to accommodate ocean shipping, a railway yard with 23 miles of track and 123 warehouses. In addition, a large cold storage installation is provided, and an unusual departure is the provision of 16 industrial buildings, in which space is available for manufacturing, at attractive rentals.

The feature of the terminal is the use of electrically-operated appliances throughout; the railway cars are shunted by electric locomotives, of which there are three 40-ton and one 60-ton trolley-type G.E.C. machines. What transportation is required between piers and railways and warehouses is handled by electric tractors, battery trucks, battery cranes, motor-driven hoists, elevators and motor-driven piling machines, while delivery and collection of freight outside the terminal are handled by electric trucks.

Shipments received by water may go direct to freight cars, or to lighters, or to trucks delivering in the city, or to warehouses or factories; similar possibilities are open to goods received by rail.

To supplement the ships' winches, portable electric hoists are provided on the piers; goods are unloaded into trucks, four or five of which are drawn by battery tractor to the warehouse, and as 12 trucks are provided to each tractor, sufficient are available for continuous loading and unloading at each end of the route, while the tractor can be kept always on the move. Where packages weigh 1,000 lb. or more, crane tractors are employed, which not only haul, but load and unload when required. Sixty portable electric hoists are employed for lifting freight into warehouses, &c., where also the electric piling machines are used for stowing.

With the older method of handling mixed freight, something like 50 per cent. of the operating cost was eaten up by inefficiencies, delays, wastes, excessive labour costs, &c.; this is eliminated by the electro-mechanical methods now in use.

For city deliveries the electric vehicles are loaded at night, for delivery early in the morning; the batteries are

charged at night, and receive a boosting charge during the day.

The *Electrical World* says that the data thus far available shows that the tractors have performed their duties with a current consumption of 3·31 ampere-hours per ton-mile. The average weight transported has been 123 tons, and the length of haul between 100 ft. and 6,000 ft., or an average of 0·4 mile. Four-wheel platform trucks, 14 ft. long by 4·5 ft. wide, and equipped with roller bearings, are employed in this service. Among the various forms in which the miscellaneous warehouse commodities are handled in the raw state are bales, bags, cases, barrels, mats, &c. Of the 1,325,000 tons of freight handled at the Bush terminal per year, about 324,000 tons is moved by tractors between the piers and warehouses. The remainder is transported in trucks or trains handled by electric locomotives.

Several typical examples will serve to show the relative advantage of handling material by electric tractors instead of by hand or with horse trucks. For instance, in loading trailers with bales of fibre, the battery cranes and tractors can perform the work at a cost of 7·2 cents per bale, whereas with hand operation it costs 8·8 cents per bale; 300 lb. bags of ore can be loaded on to cars by battery cranes at a cost of 21 cents per ton, whereas with hand operation it costs 32·4 cents per ton. In addition, the battery crane permits an average increase in speed of handling of about 40 per cent. Comparing the use of horse trucks and tractors for loading and unloading case goods and transporting them, it costs 16·1 cents per case with horse truck and 14·2 cents per case with tractors. The last two values are based on hauling the commodity 450 ft.

Storage battery tractors show an advantage also when the cost of operating them is compared with that of moving commodities in box cars. For instance, suppose that 400-lb. bales are to be moved from a lighter to a pile in the storehouse; the complete cost of operation with a battery tractor is 8·7 cents per bale, whereas when moving the material in the box cars the cost is 26·2 cents per bale. At the Bush terminal the cost of energy for loading, unloading, and transporting materials amounts to a small percentage of the total operating cost per year. Labour expenses represent 41·7 per cent. of the total operating cost. The yearly operating cost of the tractors is 66·3 per cent. of their initial cost.

The performance noted in the preceding data is rather remarkable, in view of the fact that some of the batteries are operated at 75 per cent. overload, and are unprotected from the excessive jar and vibration due to the trucks and tractors operating over the rough cobble stones and boards between the piers and warehouses. Edison batteries are used in the trucks and tractors.

The company has recently ordered 20 more 5-ton tractors.

The energy used at this terminal for freight handling, light, and power is furnished by the Brooklyn Edison Co., and averages 12 million KW.-hours a year.

The relatively high operating efficiency of electrical, as compared with other apparatus, suggests the general assumption that the energy used per ton handled—in the case of the Bush terminal, roughly 9 KW.-hours per ton—is a direct measure of the operating efficiency of the terminal organisation; especially would this be so under dear labour conditions.

The enclosed non-tidal British dock estates would probably account for a good deal more power than the river piers of the Bush terminal, especially where there are grain silos and heavy pumping requirements, and if we take the 1913 shipping tonnage figures for British ports (exclusive of coastal tonnage) as an approximate indication of the possible electrical requirements during a normal year of certain British ports, using as an overall basis figure 10 KW.-hours per ton handled, instead of the 9 KW.-hours used by the Bush Co., we obtain some startling figures, viz.:—Liverpool, 150 million KW.-hours; London, 200 million KW.-hours; Southampton, 120 million KW.-hours per annum, &c. These ports handle general merchandise, grain, &c., and are, therefore, to some extent comparable with the Bush terminal, though as their planning often dates back a good many years, even the most efficient reorganisation of method would probably involve a higher average use of energy than the American figure quoted. It is, of course, fully admitted that electrical methods are very largely employed in railway and dock terminals in this country, but the electric truck, tractor and vehicle are usually conspicuous by their absence, and the really intensive electrical methods employed by the Bush and other American concerns are unknown here.

COSTS IN ELECTRIC FURNACE OPERATION.

An interesting study of the relation of the costs of electrodes, refractories, electricity, labour, and raw materials, to total expense in electric furnace operation, particularly with reference to single electrode furnaces, was recently contributed to our contemporary, the *Electrical Review* of Chicago, by Mr. F. T. Snyder.

The author points out that there are six items of expense in electric furnace operation, viz.:—(1) Cost of electrodes, (2) cost of refractories, (3) cost of electricity, (4) cost of labour, (5) maintenance, depreciation, and investment charges, and (6) cost of raw materials.

The last item is practically unaffected by type of furnace or form of current supply, and need not be further considered.

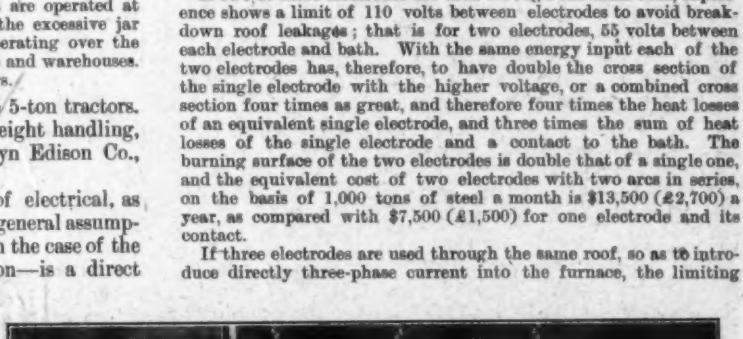
Electrode Cost.—The electrode costs the user in two ways—viz., by the burning away of the electrode and by the heat which it conducts out of the furnace. The sum of these items constitutes a charge per hour of furnace operation, and for a well-designed furnace melting 1,000 tons of steel a month represents some $6,000 (£1,200) a year *per electrode*.

It is evident that a reduction of the number of electrodes warrants serious consideration; with capital worth 20 per cent. a year the elimination of one electrode would justify an investment of $30,000 (£6,000). The ideal furnace would have no electrodes, and the induction furnace met this requirement, but unfortunately introduced defects which rendered it commercially impracticable. By using the metal bath in the furnace as one terminal of the arc, a furnace can be operated with one electrode per arc.

As three-quarters of the cost per year of each electrode is due to surface burning, the smaller the electrode the lower will be the electrode cost. The size of the electrode is determined by the current, and this (and the size) will be smaller, the higher the voltage between electrode and bath. The voltage is limited by a roof condition; silica bricks used for roofs are fairly good electrical conductors at white heat, and at steel finishing temperatures the furnace gases are rather good conductors. When current is switched on the arc will jump a considerable distance, which limits the pressure between a single electrode and the bath to about 220 volts.

If two or more electrodes are used through the same roof, experience shows a limit of 110 volts between electrodes to avoid breakdown roof leakages; that is for two electrodes, 55 volts between each electrode and bath. With the same energy input each of the two electrodes has, therefore, to have double the cross section of the single electrode with the higher voltage, or a combined cross section four times as great, and therefore four times the heat losses of an equivalent single electrode, and three times the sum of heat losses of the single electrode and a contact to the bath. The burning surface of the two electrodes is double that of a single one, and the equivalent cost of two electrodes with two arcs in series, on the basis of 1,000 tons of steel a month is $13,500 (£2,700) a year, as compared with $7,500 (£1,500) for one electrode and its contact.

If three electrodes are used through the same roof, so as to introduce directly three-phase current into the furnace, the limiting



Single-phase Doorless Electric Furnace.

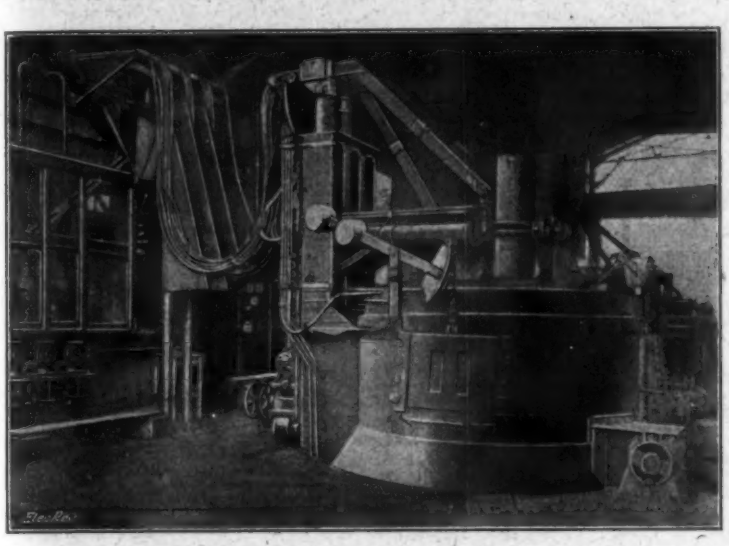
voltage is usually kept at about 110, and this results in a potential of about 65 volts between electrode and bath. With the same total input each electrode will carry one-third of the energy of a single electrode at about one-third of the voltage, and therefore each electrode will carry the same current as does the single electrode, and be the same size, the three having heat loss and surface burning equal to three times those of a single electrode.

Thus for 1,000 tons of steel per month, the electrode cost for the three electrodes will be $18,000 (£3,600), as against $7,500 (£1,500) for a single electrode and contact.

Refractories Cost.—It is the common knowledge of electric steel operation that the bulk of the refractory cost is due to roof wear, and that the roof wears most around each electrode—in other words, it is substantially proportional to the number of electrodes The cost figures from different furnaces show a total refractory cost

for three-electrode furnaces of substantially three times the total refractory cost for single-electrode furnaces. With a well designed furnace melting 1,000 tons of steel a month, this refractory cost may be kept down to $4,000 (£800) per electrode per year.

It is the maximum temperature at the end of the heat that wears the refractories in a steel furnace. As the roof walls and slag are near the same temperature, the arc radiates to each about the same. Part of this energy is absorbed by and passes through the roof and wall. In a well designed furnace this amounts to less than 10 per cent. of the total power input. Of the energy radiated by an arc, about one-half goes directly to the slag; the other half is reflected by the roof and walls. The roof and walls are therefore at a temperature between the temperatures of the slag and the arc.



SIX-TON, THREE-PHASE FURNACE, WITH THURY REGULATOR.

The energy to be radiated per sq. in. of arc surface determines the temperature to which the arc must rise to get rid of energy at the input rate. If the arc is twice as long, and remains the same diameter, it will have twice the surface and radiate twice the energy at the same temperature, or will radiate the same amount of energy at a lower temperature. The three-electrode arc voltage is 65; the single-electrode arc voltage is 220; and in each case about 35 volts are absorbed by the arc terminals. This leaves 30 volts per arc to determine the length of each of the three arcs of the three-electrode furnace and 185 volts for the single arc of a one-electrode furnace. Therefore, the total length of the single arc is more than twice the sum of the lengths of the three arcs. As this single arc has consequently to radiate only half the energy per sq. in., it will be cooler than each of the three arcs, as it does not have to back up so far to radiate its energy, and the walls from which its heat is reflected will be cooler also. While the reduction in temperature of the long, high-voltage arc does not amount to a great many degrees, the reduction in temperature comes near the melting point of the silica brick of the roof, and makes a large actual increase in the number of heats that the roof will last.

Electricity Cost.—The molten metal poured into the ladle, the hot slag, and the gases given off during melting, contain a definite amount of energy, approximating 350 KW.-hours per 2,000 lb. of steel. There are also direct losses by radiation through the furnace shell and the heat loss through the electrodes, which go on continuously after the furnace is heated up, and would represent about 120 KW. continuously in a furnace producing 1,000 tons of steel per month. If the furnace input were 240 KW.-hours, only 120 KW.-hours would be available for steel melting, at which rate it would take about three hours per ton melted, and 360 KW.-hours of heat energy would be lost, making a total energy consumption of 360 plus 350 or 710 KW.-hours per ton of steel.

If the furnace were given an energy input of 820 KW., the net energy available for melting, after losses were supplied, would be 700 KW., which would melt the ton of steel in half an hour, during which time the heat losses would only be 60 KW.-hours, so that the total energy for melting would be 410 KW.-hours per ton.

It is evident that the higher the energy input the higher will be the heat efficiency. With a three-electrode furnace the limit is soon reached, owing to lack of room to space the electrodes far enough apart to prevent current leakage through the roof. The insulation of the roof bricks can be improved by water cooling, but the heat lost to the water is greater than the heat saved by increased energy input.

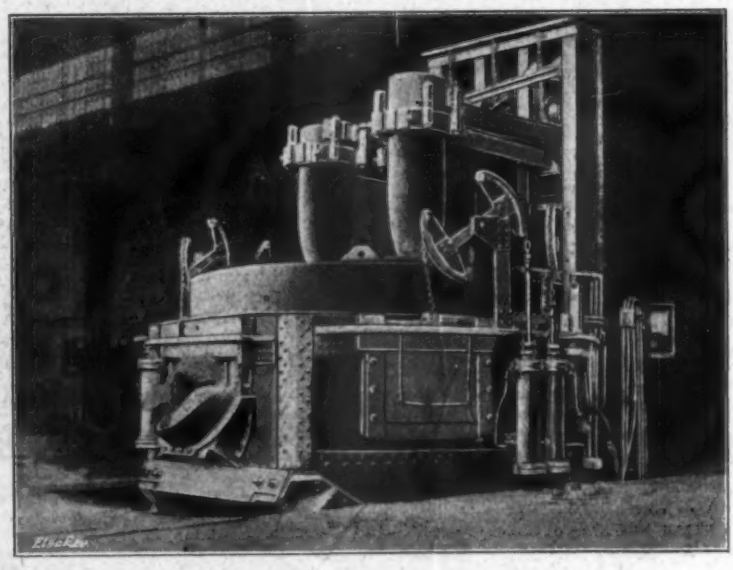
Increasing the energy input does not necessarily result in higher furnace temperatures; the latter are determined by the melting point of the metal, and cannot rise above the melting point of steel, so long as there is unmelted metal in the furnace. With a single electrode furnace no limit has been found to the rate at which power can be put into a furnace and the efficiency correspondingly raised if certain simple metallurgical precautions are taken. If energy is put in faster than the steel can be "killed" (freed of oxygen), after the steel is melted, the excess only operates to raise the temperature and melt the walls. To permit a high rate of energy input the elimination of oxygen must be speeded up; air leaks through furnace doors prevent this; the air burns up the electrode, oxidises the steel, and carries away heat in escaping. The value of the heat loss for each door of the sliding type has been determined at some $1,500 (£300) a year. Two ordinary doors may easily double the time required to finish a heat.

As it is in practice almost impossible to keep a door tight, the difficulty can be overcome by having a doorless furnace, with a tilting roof to admit the charge. A simple self-sealing joint was made by putting a narrow ring of sand on the top of the furnace wall. Any piece of scrap that the furnace will hold can be put in through the roof, while the scrap has to be cut to enter a door. The heat loss in opening up a roof is found to be much less than through a single door. The steel can be deoxidised as it is melting, and, when melted, can be poured, reducing the time taken.

Labour Cost.—The open roof furnace enables charging to be done with a dump bucket and crane, and such a furnace can be operated by one melter and a helper, or, if of less output than 500 tons a month, without a helper.

A single high-voltage electrode is lighter to handle, and requires less time for adjusting than three electrodes; high voltage has another advantage, as with a single electrode arc about 185 volts are available for arc length, which gives an arc about 5 in. long, and the rising of a slag bubble ¾ in. reduces the arc resistance less than 20 per cent., whereas the 30 volts available in a 65-volt three-electrode arc only allows of ¾ in. arc length, so that each time a slag bubble comes up under an electrode, the power load is short-circuited in the arc.

For this reason the boiling of the bath does not take any of the melter's time with a single-electrode furnace, but takes all the time of one man with a three-electrode furnace. To overcome this difficulty



SIX-TON ELECTRIC ARC FURNACE.

three-electrode furnaces are provided with automatic regulators, which, however, have yet to demonstrate their value as labour-savers.

A doorless single-electrode furnace only uses ⅓ the weight of the electrode per ton of product used by a three-electrode door-type furnace, and this represents a substantial saving in labour in handling; the roof with one electrode hole also lasts longer, and these items, summarised, mean that some $4,000 (£800) per year will be saved in labour cost in producing 1,000 tons of steel a month in a single-electrode doorless furnace.

Maintenance, Depreciation, and Interest Charges.—The three-electrode equipment is obviously more costly in maintenance and depreciation than the single-electrode equipment, especially if automatic regulators are employed with the former. As the single-electrode furnace can be operated at double the speed of the other, the original investment and interest on first cost are also less. With 1,000 tons output per month, the difference due to these items will reach $6,000 (£1,200) per year. Summing up the various items in favour of the single-electrode furnace for the output assumed, the total saving will reach $36,500 (£7,300) a year. As a well-designed furnace requires an energy input of about 800 KW. for an output of 1,000 tons of steel per month, this saving equals $45 (£9) per year per KW., and this is a good return on the investment required to change the standard three-phase current distributed into either single-phase or direct current suitable for use in a one-electrode furnace.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The City Guilds' Lists of "Works of Reference."

We should like to be permitted to place it on record that success has at length crowned the repeated, and almost single-handed, efforts of Mr. Sidney Rentell, A.M.I.E.E. (editor of your contemporary *Electricity*), to bring about an improvement in the lists of Works of Reference relating to the electrical subjects.

For more years than would be believed, these lists (which are published in the Institute's Annual "Programme") have been in a state of suspended animation; excepting that for "Electrical Installation (late wiremen's) Work," which is of recent growth.

The waking-up of the City Guilds' authorities to the absurdity of recommending out-of-date and out-of-print books, and not including new ones, year after year, is, without doubt, mainly due to Mr. Rentell; and he has done a great service to students, to teachers, to authors, and to readers generally.

How has he done this good work? By repeatedly reprinting the lists, and showing what books were out of print, and, in some cases, for how long; by opening his columns to letters and articles of protest; and by a certain very direct method which, apparently, did not fail to have final effect.

No longer (or we had better say, not for some time) will the teacher, student, or other person interested in electrical engineering books be confronted with a list starting with a book that has been out of print for a quarter of a century; and including about 10 others that ceased to exist a varying number of years ago.

No longer will people run the risk of having an order for a book returned with the doubly-irritating information that the work is out of print, and that the publisher retired from business when he (the orderer) was a boy at school.

Some 17 books have been thrown out of the Electrical Engineering List, and about 30 new ones have been added. The value of the list is increased by dividing the 60 (or so) works into classes, but is considerably diminished again by omitting to give the publisher's name in nearly a score of cases.

We will not venture to criticise the new works of reference selected, but we notice that Mr. William Cramp is credited with "Continuous-Current Design," and that Mr. Aspinall Parr has become Aspinall & Parr.

The lists for "Telegraphy and Telephony" and for "Electro-Metallurgy" have not been subjected to such an extensive overhaul.

A. P. Lundberg & Sons.

Islington, *August 29th*, 1917.

Fault Localisation.

I have read with interest the articles on fault localisation by Mr. H. E. Blake and others in recent issues of the REVIEW. These articles show some ingenious methods of locating faults and overcoming all difficulties but the one which, in my experience, occurs most frequently—*i.e.*, the reduction in cross section of the copper conductor at the fault due to arcing or corrosion.

An instance of such corrosion is mentioned by Mr. D. M. W. Hutchison in his article on "V.B. Cable Breakdowns in the Tropics," and I have found this reduction in cross section in nearly all cases of faults on L.T. cables.

A sketch of a cable corroded or burnt is given in fig. 1, and it will be seen that the actual point at which the current leaves the faulty conductor may be at A, B, or C, or anywhere else on the corroded portion, a similar effect being produced by a loose ferrule due to the melting out of the solder when the fault occurs in a joint box.

The problem then is to find the fault under the conditions as drawn in fig. 2, where A, B, C, or D represent the unknown resistances of the corroded or burnt portion of the conductor at the fault, and F represents the fault resistance, which can be eliminated by use of a bridge method of testing.

If the resistances A, B, C, D are neglected, the probable result is that one is entirely misled as to the position of the fault, particularly as the portion of the conductor between A and C, in fig. 1, may consist of carbonised insulation or globules of copper, iron, and lead, the resistance of which for a 1-in. length may be equal to some hundred yards of the copper conductor.

The induction method is of very little value as a check when lead-covered or armoured cables are concerned, as one may easily be led streets away by the pranks of the leakage current, which has been known on several occasions to affect a search coil strongly in a street where no cables were laid, the gas pipes providing an easy path back to the station earth-plate.

In the case of a short circuit between lead-covered single cables, the induction method may be used by means of a rectangular search coil laid over the cables, with its long sides parallel to the

FIG. 1.

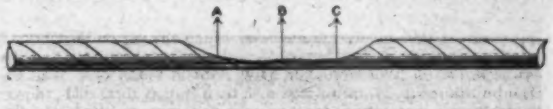


FIG. 2.

faulty cable; if there is an earth on as well as a short circuit it will be necessary to use an unearthed source of current for testing.

In the case of V.B. single cables the induction method is of great assistance in finding out earths or short circuits, the only difficulties being the presence of adjacent water or gas pipes, along which the leakage current tends to flow, and the fact that faults are often of high resistance, due to the self-sealing character of the insulation.

These high-resistance faults only allow a small testing current to be passed, but this can be made much more effective by connecting a condenser across the contacts at which the current is interrupted when D.C. is used.

I have also experimented with detectors used in wireless telegraphy, the fault being used as a spark gap fed from an induction coil, Hertzian waves being generated and used to affect the detector; this method may prove to be of assistance in finding open circuits, but one cannot now experiment owing to the restriction due to the war.

In conclusion, while the bridge and other methods of fault finding are useful, it is very gratifying when using those methods to be informed of a "hot flag" somewhere over the faulty cable.

W. Redmayne.

Electricity Works, Rotherham,
August 28th, 1917.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Vislock Lock Nut.

The necessity of preventing nuts from slacking-off when once screwed up has long been recognised by engineers, and very many devices have been employed from time to time with a view to securing that result.

In recent years the extending use of mechanical road vehicles under conditions in which excessive vibration is necessarily present, has brought the matter into greater prominence, and as in the future adequate locking for nuts will probably be an

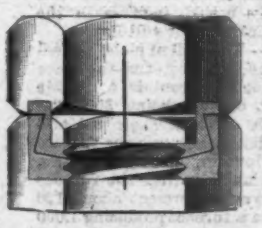


FIG. 1.—SECTIONAL VIEW OF THE VISLOCK NUT.

indispensable feature of machine design, especially where, as for instance, in certain classes of electrical machinery, there is a natural tendency to slacking-off through vibration, some interest attaches to the subject.

Of the various devices which have been introduced, probably the Vislock lock-nut is as well known as any; it is simple and self-contained, and indistinguishable in appearance from the ordinary lock-nut arrangement which has been the standard—though frequently ineffectual—practice for many years.

The makers of the Vislock nut have now had four years' experience with their products in daily use on a very extensive scale, which leaves little room for doubt as to the effectiveness of the device, which, our readers may remember, consists of two nuts, which are mechanically connected by an internal shank extending below the upper nut into a specially-shaped recess in the lower one.

and depends for its utility on the wedging action produced between the bolt and nut threads in this recessed portion, when the upper nut is rotated relatively to the lower one.

The Vislock nuts are made by Vislock, Ltd., of 3, St. Bride's House, Salisbury Square, E.C., in British Standard Whitworth sizes from ¼ in. to 2 in. diameter, the bigger sizes (1¼ in. to 2 in.) being specially made for heavy machinery; they are also made in B.S. fine-thread sizes from ⅛ in. to 1½ in. diameter; two depths are supplied, 1 and 1½ times B.S.W. and B.S.F. standard.

New Armature Winding.

Mr. Philip C. Jones, of 111, Woodstock Road, Belfast, sends us the following description of a new method of winding armatures, for which a patent has been applied for:—

Fig. 2 shows the coils all assembled on the core, and it will be noticed that the stampings are built so that the slots run in an arc of a circle.

The coils are wound on a circular former made in two halves, and of simple construction. One side of the coil is fitted into the slot, and requires no more forming, on account of the shape of the slot; a glance shows how insulation from core and between layers is effected.

The removing of a damaged coil without damaging others, and the making of the coils, are reduced in this winding to simple matters. The time required for winding the complete armature is greatly reduced, and a saving of copper is made through so little wire not being under the poles.

In the case of an armature of 6 in. diameter, with winding slots ¾ in. deep, with an ordinary winding ¾ in., would be required for bottom and top layers, but with the new winding ¾ in. slot depth only is required, the other side of coil being spread evenly over the periphery, thus reducing depth of winding from poles to ⅜ in., with consequent advantages.

Fig. 3 is a view of a complete winding, showing the symmetrical appearance of armature. The winding is primarily intended for the smaller armatures.

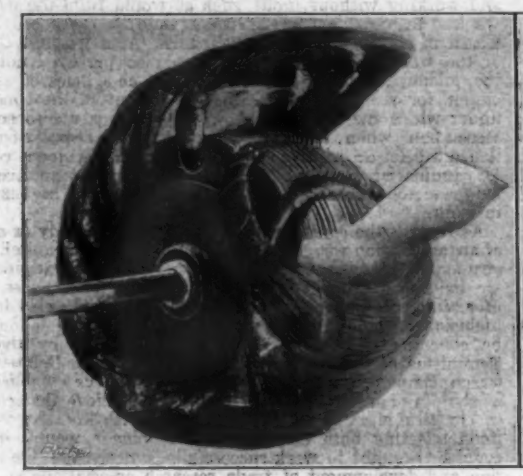


Fig. 2.—Assembling Armature Coils.

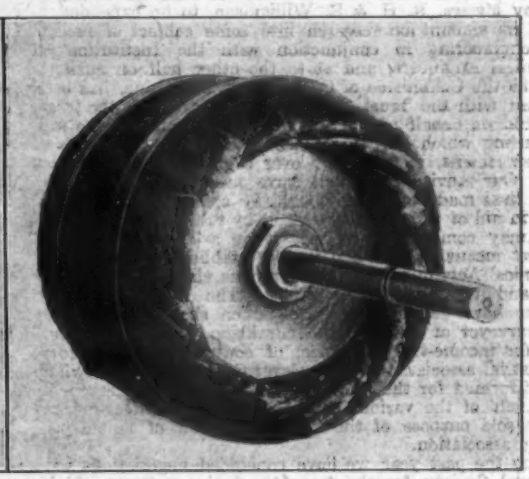


Fig. 3.—Finished Armature Winding.

Improved Method of Time Checking.

It is surprising how many employers there are who have up to the present failed to realise the great advantages to be gained by installing some system of departmental time checking for their workpeople, and it is still quite common to find large works where the employés deposit their time check when passing through one or more of the entrance offices, leading into the works, after which checking probably five minutes is lost by a fair proportion of them in reaching the particular part of the works where their employment lies. In these works it is to be noticed that the workpeople generally do not start actual work until the last of the "stragglers" has arrived. Firms who have installed departmental checking will substantiate the fact that all their workpeople being in their respective places when the works buzzer sounds, automatically start work almost directly. To meet the needs of works where a simple means is required of recording the actual presence of the employés in their respective departments at the allotted times at the various periods of the day, a system has been invented and patented by a large engineering firm in the Midlands, and whilst this was primarily designed to meet their own needs, the apparatus has proved so low in first cost, absolutely reliable in use, foolproof, and infallible in action, that it has been decided to manufacture the whole outfit and place it upon the market.

In this system a cabinet is placed in each department. On the front of the cabinet is an indicator showing for which time the checking is at the moment operating, a slot into which the workman places his check, and a metal scoop into which the check is returned to the workman should it be placed in the cabinet "after time." All the cabinets are simultaneously electrically controlled from one central point, the actual control being operated either from a clock or by the works time-keeper.

In the particular works for which this system was designed, the cabinets are opened at 5.45 each morning, and remain open until 6.5 a.m., the indicator during this period showing "Early." At 6.5 a.m. one of the electrical circuits being momentarily connected up the indicator then shows "6.30," and all checks are diverted into another part of the cabinet. At 6.30 a second electrical connection is made, after which the indicator shows blank, and checks dropped through the slot are returned to the workman through the front of the cabinet, the man having tangible proof that he is "too late."

The breakfast time being 8 a.m. to 8.30, the cabinet remains closed till 8.15, when the above process is repeated, and the cabinet remains open till 8.30. At dinner time, 12.30 to 1.30, the cabinets are opened at 1.15 and closed at 1.30.

The checks actually drop into a "transit" box, placed and locked inside the cabinet. This box has two compartments to receive the "early" and 6.30 checks, as it remains in the cabinet until the same is closed at the latter time. The transit box has a spring lock lid, and is made in such a manner that it is impossible to take it out of the cabinet without the lid being closed and locked. There is therefore no possibility of checks being inserted whilst the boxes are in transit between the cabinets and time office, where the boxes are emptied and the check numbers entered up on to the daily time sheets for payment. The system is adaptable for almost any conditions of working hours, as there are three distinct "times" or "blanks" available. The electricity consumption is negligible, amounting to only a few pence in the whole year, as the current is only on momentarily at each operation. Further particulars may be obtained from Mr. G. E. Allin, 21, Dairy House Road, Derby.

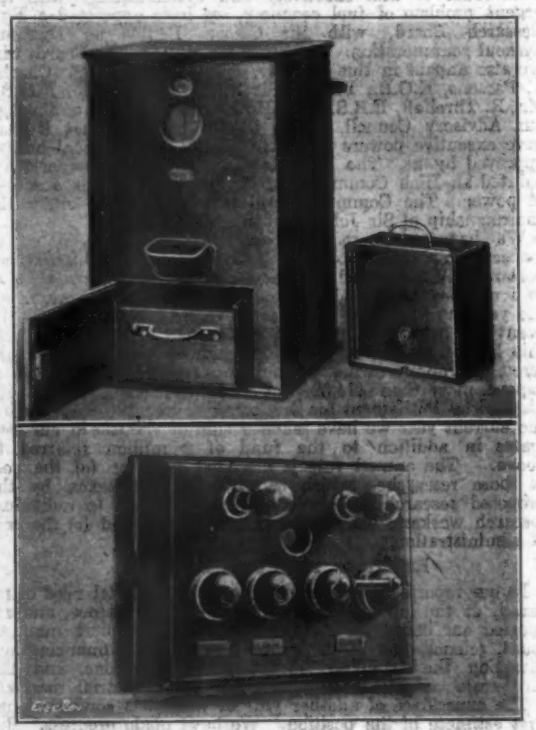


Fig. 4.—Time-checking Cabinet, with Spare Transit Box.

Fig. 5.—Control Panel for Operating Cabinets.

SCIENTIFIC AND INDUSTRIAL RESEARCH.

The following is an abstract of the report of the Committee of the Privy Council for Scientific and Industrial Research, for the year 1916-17 (Cd. 8,718; price 3d. net):—

Since we last reported, Lord Crewe and Mr. Henderson have been added to our Committee under supplementary Orders in Council.

On December 1st last Lord Crewe, the Lord President of the Council, announced that the work of the Committee of Council for Scientific and Industrial Research had been established as a separate department, with offices in Great George Street. As the work of the Advisory Council developed and the industrial side of research grew in bulk and importance, it became clear that a separate organisation, having its own estimates, in charge of a minister responsible to Parliament, was a necessity. The foundation of the new department led to the creation of the Imperial Trust for the Encouragement of Scientific and Industrial Research. A donation of £1,000 made by Messrs. R. H. & R. Williamson, to be expended as to half its amount on research into some subject of mechanical engineering in conjunction with the Institution of Mechanical Engineers, and as to the other half on such research as the Committee of Council may determine, has been deposited with the Trust. It is also intended that the Trust shall hold on behalf of the Department the sum of one million sterling which Parliament has voted for the purposes of the Department, to be spent over a period of five or six years. Our Advisory Council have recommended that the money thus made available should be spent in the form of grants in aid of research undertaken by firms in any industry which may combine to conduct it on a co-operative basis. The best means to this end is the establishment under the Companies' Acts of associations for research limited by guarantee and trading without profit. The Board of Inland Revenue have decided that no objection shall be offered by their surveyor of taxes to the admission, as a working expense for income-tax allowance, of contributions by traders to industrial associations under Government supervision which may be formed for the sole purpose of scientific research for the benefit of the various trades, or specifically ear-marked for the sole purpose of the research section of an adapted existing association.

During the past year we have concluded negotiations with the Royal Society for the transfer of the property of the National Physical Laboratory, together with the responsibility for its maintenance and development, to this Department. The scientific management of the laboratory will remain in the hands of the Executive Committee under the chairmanship of Lord Rayleigh, a member of our Advisory Council.

In order to deal effectively and systematically with the urgent problem of fuel economy, we have appointed a Fuel Research Board, with Sir George Beilby as Director, without remuneration. The other members of the Board, who are also unpaid in this capacity, are:—The Hon. Sir Charles A. Parsons, K.C.B., F.R.S.; Sir Richard Redmayne, K.C.B.; Mr. R. Threlfall, F.R.S. The Board will report to us through our Advisory Council, but it is our intention that it shall have executive powers within the limits of an annual budget approved by us. The Fuel Research Board has recently appointed an Irish Committee of Inquiry into peat as a source of power. The Committee will meet in Dublin under the chairmanship of Sir John Griffith.

We have considered and approved recommendations in respect of aid to 44 scientific investigations of industrial importance. We reported last year that we had approved grants to a number of individual students and research workers for the year 1916-17 to an amount not exceeding £6,000. In the event we have not expended more than £3,550 odd under this head upon 36 workers. Throughout our work has suffered in amount owing to the war, and we were unable to expend more than £14,524 out of the £40,000 placed at our disposal by Parliament for the financial year 1916-17. During the current year we have taken a sum of £38,050 in our estimates in addition to the fund of a million referred to above. The annual vote is intended to cover (*a*) the cost of those researches which will not be undertaken by the proposed research associations; (*b*) the grants to individual research workers, both students and others; and (*c*) the cost of administration.

Report of the Advisory Council.

In our report of last year we discussed the vital need of research at the universities, especially in pure science, and expressed our belief in co-operation between capital, management, science, and labour as the best means of financing and directing the extended laboratory investigations, and the large-scale experimentation required for industrial research.

The experience of another year of work has confirmed our first estimate of the position. We have made progress. But the progress must be slow, for the calls of war continually grow, and the numbers available for other work, however important, continually shrink.

We have addressed ourselves during this year in the main to the organisation of industrial research, first, because we felt the paramount importance of arousing and securing the interest of manufacturers in the application of science to industry, and, secondly, because the influence of the war has created in industry an atmosphere conducive to the growth of new ideas, whereas it has unfortunately made the prosecution of work in pure science and in its organisation a matter of extreme difficulty.

Organisation.—The one question of policy, to which throughout the year we have continuously devoted our attention, is the working out, with all the care and advice we have been able to command, of the policy of co-operative industrial research foreshadowed in our last report. Association and combination are "in the air," and many trade associations have come into existence during the past year, some of which include research among their objects. The intention of the Government is to make a contribution to the assured income of such associations from the subscriptions of their members, varying in amount according to circumstances, and with a normal maximum of pound for pound, though in very exceptional cases this limit may be exceeded.

We proceeded to draft a model Memorandum of Association for companies limited by guarantee of nominal amount and working without profit, such as would fulfil the purposes we had in view, and at the same time be registered by the Board of Trade under the Companies' Acts without the use of the word "Limited." We have also prepared notes for the guidance of those desiring to draft the articles of an association for research, and a short statement of the conditions under which the Department would make grants to such an association when founded. Further, the Department has issued a brief descriptive leaflet on "The Government Scheme for Industrial Research," which explains in non-technical language the manner in which the associations are expected to work.

As regards the constitution of the governing body or council of an association for research, it is obvious that capital, management, and science must have suitable representation. But we believe, further, that greater success and a wider scope of action will be attained if provision is made also for the inclusion of labour. In most cases only skilled labour will be concerned. The interim report just issued by the Sub-Committee of the Reconstruction Committee on Relations between Employers and Employed advocates the establishment of standing joint industrial councils. We believe that councils so constituted as to be able to discuss with knowledge questions affecting both employés and employer would, if they could be brought to work successfully, greatly help the formation and development of trade research associations.

Substantial progress has already been made towards the establishment of a National Research Association by the great staple industry of cotton. The woollen and worsted manufacturers of Great Britain have appointed a provisional committee to draft the constitution for a research association. The Irish flax spinners and weavers have decided to take the same steps. The Scottish shale oil industry and the photographic manufacturers have decided to establish associations immediately, the electrical engineering firms and the British Society of Aircraft Constructors, in conjunction with the Aeronautical Society, have the matter under consideration, the Scottish shipbuilding and steel industries are moving, and it may be possible to establish an association for research into the non-ferrous alloys in the near future. The British iron puddlers and the Diesel engine manufacturers have independently established research organisations for the benefit of their respective industries. The coal mining industry is interested, but it will necessarily take time to organise this huge industry on a national basis.

There will remain, however, important fields for industrial research which we can never hope to cover by means of research associations. Research into fuel is one of these. The Committee of Council have accordingly established the Fuel Research Board as a part of the Department. The researches we are conducting through the British Fire Prevention Committee and the Concrete Institute respectively into the fire-resisting and other properties of different kinds of concrete, are also cases which call for national action. The same considerations hold good for the scientific problems underlying illuminating engineering and cold storage.

By far the most fundamental work initiated during the year, so far as the industrial aspect of our labours is concerned, has been the appointment by the Committee of Council on our recommendation, of a Director of Fuel Research, with a Fuel Research Board to assist him in laying his plans.

The services of Prof. Bone, F.R.S., of the Imperial College, were retained, with the consent of the College Governors, as consultant to the Board. The British Association Committee on Fuel Economy is prepared to place the valuable information it has collected at the disposal of the Fuel Research Board, and the Director may anticipate the active help of its members either in their individual or corporate capacity as occasion may arise.

The Fuel Research Board have already presented their first report outlining their proposals for taking stock of the coal resources of each district, classifying according to their qualities the seams which are being worked or which might, in certain circumstances, be worked, and ascertaining broadly the industrial uses to which the different kinds of coal are being put. It is intended, with the help of the coalowners, to collect typical specimens of the coal seams of the various coal mining districts, and to examine and classify them by means of chemical and physical examination in the laboratory. On

the more theoretical side it is intended to conduct investigations into the nature and origin of the various types of coal, and into the chemical and physical behaviour of their constituents under the action of heat and other agents, beginning with the well-defined types of coal as they occur in commerce.

The work of the Fuel Research Board, like that of the Provisional Committee on Research into Cotton has been in the main preparatory. Neither body has yet done much in actual research, for they have been doing the careful thinking without which ideas are barren.

We have, however, recommended that grants should be made for three pieces of research which are related to the work of the Fuel Research Board. The first of these is being carried on at the Manchester Municipal School of Technology, and has for its objects the use of better methods of domestic heating, and improvement in the ventilation of dwelling rooms. A grant has also been given to the Institution of Heating and Ventilating Engineers to enable them (*a*) to tabulate and print the result of five researches on domestic heating carried out at University College, London, during the past three years, (*b*) to carry out a research with a view to establishing coefficients of heat transmission through standard building materials, and (*c*) to conduct an investigation on heat transmission from radiators.

The third grant will secure the continuance of the work begun in 1912 by the Committee for the Investigation of Atmospheric Pollution.

A grant made in November last to the Institution of Mining Engineers to enable them to investigate (*a*) the influence of hot and moist atmosphere on workers employed in mines, and (*b*) the methods to be employed for cooling and drying the atmosphere of mines, will lead, we hope, to an improvement in the circumstances in which a large number of miners work. Since the grant was made the principal coalowners have been considering the establishment of a National Association for Research, which could undertake this and other researches affecting the industry.

The Ministry of Munitions and the firms concerned have co-operated with the Department in a series of experiments intended to remove the difficulties experienced by English manufacturers of X-ray bulbs. We have retained Dr. Willows, of the Sir John Cass Technical Institute, to direct the investigations. Certain results of value have already been obtained.

(*To be concluded.*)

WAR ITEMS.

When the Nights Draw In.—A correspondent with the Forces in France, writing under date August 23rd, says:—"Until I came out here, five months ago, I had not missed an issue of the REVIEW for years. We do not get very much time for reading, but now that the nights are drawing in we shall probably find the time hanging rather heavily, and a perusal of the REVIEW will be profitable and keep us abreast of the times. I am afraid we shall not be able to reply to any of the 'Situations Vacant,' however. I daresay you would be very amused if you knew of some of the jobs that we electrical men are called upon to do, but I was very pleased to hear a sergeant say one day that he liked to have electrical men in his section, because they were so adaptable! We get some very interesting jobs, and get over them in record time. Only a couple of weeks ago we installed a complete plant, engine, generator (bed for same), mains, and switchboard, after 6 o'clock in the evening. We are just keeping in training for all the extensions to plant after the war. I only hope that that happy time will soon be here."

Discharged Soldiers and Motor Work.—The Central Committee for the Employment of Discharged Soldiers and Sailors draws attention to the position of such men with respect to the motor industry. It is considered inadvisable for men who have not already trained as drivers to do so now. Among the reasons given are the cancellation of private petrol licences and the difficulty at present found in obtaining work for highly-skilled men of many years' experience. Thousands of unskilled men who were enlisted and are now, after training, coming back to civil life, will be anxious to remain at motor work. Although there is, generally speaking, an over-supply, the committee say there is a certain demand for men who are capable of undertaking work on commercial cars and on agricultural tractors, but in both cases the work is somewhat heavy, and therefore not suitable for men who have been badly injured.—*Times.*

British Westinghouse War Relief Fund.—A full statement of receipts and payments in connection with the British Westinghouse Employés' War Relief Fund was submitted to a meeting of delegates held on Friday last in the Women's Canteen at Trafford Park. The number of employés with the Forces to date is 2,702, and the casualties have been exceedingly high. The dependents who received allowances at June 30th, 1917, was 718. The accounts cover the period from August 24th, 1914, to June, 1917. The total receipts stand at £44,108, £29,103 of which was contributed by employés and £13,990 by the company, the remainder consisting of donations and interest. There has been paid out to dependents £25,836, £11,678 has been set aside for a Disablement and Dependents' Fund, and over £2,060 has been spent in donations to local and national funds, Christmas gifts, and payments to Red Cross workers.

Trading with the Enemy.—The "London Gazette" for August 31st contains a further list of persons and bodies in the following countries with whom trading is prohibited:—Argentina, Paraguay, Uruguay, Brazil, Chile, Colombia, Greece, Netherlands East Indies, Norway, Peru, Spain, and Sweden, also particulars of a number of removals from previous lists.

German Industrial Census.—According to the "Hamburgischer Correspondent," a census was to be taken on August 15th of all industrial and trade establishments throughout the German Empire. The object of this census is stated to be the collection of statistical data considered necessary for the successful economic prosecution of the war and to facilitate the transition of the German economic system from war to peace conditions. The census was to include all Germans engaged in industry, whether as manufacturers, independent master craftsmen, tradesmen, or home industrial workers, and was to be carried out through municipal and communal authorities.—*Financier.*

Small Supplies of War Material.—According to the *Morning Advertiser*, at the West Ham Court, last week, Samuel Coster, 43, an electrical engineer, was charged, on remand, with entering into negotiation, without a permit, for the sale of 30½ lb. of alloy worth £16; and also with having under his control alloy required for the production of war material. Detective-Sergeant Mould said he had been to the Ministry of Munitions, and he was told that there was no intention to prosecute, it being held that the Act was not intended to apply to such small quantities. The accused was then discharged.

Reconstruction in France.—A law, promulgated on August 5th, authorises, *inter alia*, the Minister of Commerce, Industry, and Posts and Telegraphs to expend a sum not exceedings 250,000,000 frs. (about £10,000,000 at par) on the purchase of raw materials, plant, &c., necessary for the re-establishment of industry in the invaded districts of France. Plans for the purchase of material, &c., will be drawn up by three Commissioners acting under the direction of an Office of Industrial Reconstruction, consisting of eight representatives of the Government Departments concerned and eight representatives of commerce and industry (of whom four are to belong to the invaded districts). The Office is to be established at the Ministry of Commerce.—*Board of Trade Journal.*

Where Germany gets Copper.—The Serbian copper mines are now being intensively exploited by the Germans and Austrians, and good copper deposits are also said to have been found in Poland. Work has recently begun in the lead and copper deposits in the district of Kielce, and in the neighbourhood of Miedziana, Lysa Gora, and Olkusz the methodical exploitation of these ores has already been started. The existence of copper in this district has long been known, but under Russian rule the deposits were neglected, as the authorities devoted all their attention to the exploitation of the mines in the Urals.—*Ironmonger.*

Niagara Power and Munitions.—The "Times" correspondent at Toronto reports Mr. Lucas, Attorney-General of Ontario, as believing that a revision of the treaty between Great Britain and the United States regulating the use of the water of Niagara Falls may be necessary. "There has been an acute shortage of power in Ontario. Under the treaty the United States is allowed to use 20,000 cu. ft. a second and Canada 36,000 cu. ft. Recently the Ontario Hydro-Electric Commission secured an Order in Council authorising the expropriation of exported power in order to relieve the situation. But even this does not meet the domestic demand. If export is prohibited many American industries will be embarrassed. The increased use of power on both sides is largely due to the demand for the manufacture of munitions. It is suggested that the treaty be revised to allow both countries to divert more water from Niagara river."

Indiscriminate Granting of Trade Protection Cards.—At Bermondsey, Messrs. Sadler & Co., engineers, in applying for the further exemption of a turner and fitter, 37, passed for labour abroad, stated that they had applied for a trade protection certificate for the man, but had been told by the officers that they had better stick to the Tribunal as long as they could. Consequently they were not granted a certificate. The Military Representative (Lieutenant J. A. Davis) said this man was fully entitled to the protection certificate. These certificates were being issued to men not entitled to them, but men fully entitled to them could not get them. In one case he learnt that a boy of 19 had been granted a certificate, and on visiting the factory where he was employed he found that he had been granted a protection certificate for the stamping of cakes of soap. On the day of his visit a woman was doing his work, as the boy was away on holiday. In another case, a man, 26 years old, passed for general service, engaged by a firm of coal merchants doing odd jobs in their coal wharf, had obtained a protection certificate. The Tribunal had refused his appeal for exemption,

and he had lodged an appeal with the Appeal Tribunal, but whilst his case was pending he obtained the protection certificate. He thought the Tribunal ought to draw public attention to the way these protection certificates were being obtained. The Tribunal instructed the Town Clerk to communicate with the Government Department responsible for granting the protection certificates, drawing attention to the indiscriminate manner in which they were being issued. Applicant was granted two months' exemption.

At Camberwell, Mr. W. J. A. Westcott, 35, passed for general service, managing director of Messrs. Arthur Adams and Co., Ltd., tin box manufacturers, of Meeting House Lane, Peckham, appeared, at the request of the Military Representative, to show cause why his certificate of conditional exemption should not be withdrawn. He informed the Tribunal that he had been granted a card of exemption under the Protected Trades Schedule. The Military Representative said that this was not a business of national importance. Mr. J. Nisbett replied that evidently the Ministry of Munitions thought it was, for they had granted him an exemption certificate. Applicant said he held direct Government contracts for the manufacture of tin boxes. The Military Representative said there were many men in the borough holding these trade cards engaged in businesses which were not of national importance, and they did not know under what conditions they were obtained. He did not wish to reflect on this case, but he found that all sorts of dodges were being resorted to in order to get the cards. Tin box manufacturers were not included in the list of certified occupations, and he thought the man ought to join the Army. Sir Evan Spicer said the question for the Tribunal was whether this business was to be thrown away, even though it had grown out of the war. The Military Representative said if they were going to keep young men like this out of the Army, especially if they were fit, they might as well "throw up the sponge." It was decided to cancel the exemption granted by the Tribunal, which deprived the appellant of any further right to an appeal at the Tribunal should his card be withdrawn by the Ministry of Munitions.

Exemption Applications.—At Batley, three electrical engineers' certificates were reviewed. H. Hainsworth (37, in charge of a large engineering firm), who possessed an M.A.R.O. certificate, and had been working 90 hours a week on shell factories contract work, was given a renewal of conditional exemption. A. Brook (38), electrician, with M.A.R.O. certificate, was also given conditional exemption. H. Jagger (37) was told to apply for an M.A.R.D. certificate, and submit himself for medical examination.

At the Hull Tribunal, Mr. T. Holme, the Corporation telephone manager, applied for exemption certificates in the place of the existing blue cards granted by the Military Representative to 15 telephone employés. In reply to a question as to what was the position of the military in relation to these men, Captain Chapman said that they were already exempted, but the certificates granted were now out of date, and they required Tribunal certificates, to which the military offered no objection. The Humber Garrison and the York Command had told them what they had to do, and the telephone employés had to do it. As a matter of fact, he believed every one of the men would have to go under military control absolutely. In regard to replacing the A men, Mr. Holme said the 15 names were put forward in agreement with the local military authorities and themselves for substitution. They also communicated with the National Service Department, and gave details of the men they wanted. Only four had been substituted, and that was why he was making the application. It was not suggested that the whole of the 15 should be substituted, but only those under 31 years of age. Mr. Gibson asked if there was any objection to the men doing four hours per week dock guard duty, and in order that the decision of the military might be obtained, the issue of the new certificates, which was agreed to, was deferred.

At the Hull Tribunal, the Tramways Committee applied for three men engaged as armature winders. One was classified B1 and the other two C1. The staff had been before the Advisory Committee, who had taken all the A men. A representative of the department said that if these men were taken it would mean that the whole tramway system would be stopped. Conditional exemption was allowed.

At the South Yorkshire Military Appeals Court, on Saturday, 17 cases concerning employés of the Rotherham Corporation tramways were considered. According to the *Yorkshire Post*, in each case the Military Representative appealed against an exemption granted by the Local Tribunal. Fifteen drivers were among those concerned. The statement submitted on behalf of the Corporation was that they were doing their best to get substitutes, as shown by the fact that they had arranged to release six of the 17 men as soon as substitutes were efficient. They had 30 substitutes sent down, but only 10 remained. The traffic manager informed the Chairman that it was not desirable to utilise women as substitutes for motormen, as was done in Doncaster and elsewhere, as the gradients on some of the routes were dangerous. Two of the men were ordered to join up, and others were given until November 30th, but the Chairman said the Tribunal felt strongly that all the men should eventually find their way to the Colours. The exemption would not be made final, and the management had better do all it could to find substitutes, women or otherwise, as the prospect was that the men concerned would have to go.

Renewed exemption to January 1st has been granted to A. A. Clements (36, C1), electrical engineer, Taunton.

At Surbiton, the Electricity Supply Co. appealed for a meter mechanic (27, C2), and three months were conceded.

At Oxford, the Military appealed against conditional exemption held since June 19th, 1916, by W. Bush (40, B1), scientific electrical instrument maker, engaged at the Electrical Laboratory, Parks Road. Prof. Townsend stated that Bush was engaged on the construction of wireless apparatus for the Royal Naval Air Service, under his direction, and Lieutenant Owen said that he ought to be protected by the Admiralty. The exemption was cancelled.

Bath Tribunal has granted three months' exemption to A. H. Leonard (29, C2), electrical engineer at the Grand Pump Room Hotel.

At Whitby, the electrical engineer to the U.D.C. (Mr. J. Piggott) appealed for a shift engineer (19, C1), and said that an efficient substitute, suggested by the Military, would require months of training before he could satisfactorily undertake the work and acquire local knowledge of the situation of cables, &c. The appeal was disallowed.

Before the Eton Rural Tribunal, exemption was sought for V. H. Froud (37, B2), electrician at the Stoke Park Golf Club. Three months were allowed, the case to be then reconsidered.

At Oxford, a review was made of exemptions, granted on the ground that they were necessary for the efficient running of the services, to H. Wyatt (31, general service) and F. L. Chatwin (33, general service), engaged with the Oxford Tramways Co. The company claimed that the men were indispensable, but the appeals were allowed, and a month's temporary exemption granted, with leave to appeal again.

IMPORT TRADE OF PERU.

The following statement, showing the imports of electrical and allied goods into Peru during the year 1915, is extracted from the recently-issued trade statistics. The figures for 1914 are added for purposes of comparison, and notes of any increases or decreases are given:—

	1914.	1915.	Inc. or dec.
Electrical apparatus.—	£	£	£
From Germany	1,000	200	– 800
,, United States ...	1,500	2,000	+ 500
,, Great Britain ...	700	—	– 700
Total	3,200	2,200	– 1,000
Copper wire and cable.—			
From Germany	50	500	+ 450
,, United States ...	850	5,000	+ 4,150
,, Great Britain ...	—	1,500	+ 1,500
,, Other countries ...	250	500	+ 250
Total	1,150	7,500	+ 6,350
Incandescent lamps.—			
From Germany	3,000	1,300	– 1,700
,, United States ...	1,200	2,300	+ 1,100
,, Great Britain ...	200	500	+ 300
,, Other countries ...	—	1,400	+ 1,400
Total	4,400	5,500	+ 1,100
Telephone apparatus.—			
From Germany	400	100	– 300
,, United States ...	400	300	– 100
,, Other countries ...	200	100	– 100
Total	1,000	500	– 500
Pumps.—			
From Germany	200	500	+ 300
,, Belgium	300	500	+ 200
,, United States ...	11,500	8,000	– 3,500
,, Great Britain ...	1,500	500	– 1,000
Total	13,500	9,500	– 4,000
Boilers.—			
From Germany	1,000	500	– 500
,, Great Britain ...	4,500	800	– 3,700
,, United States ...	1,500	100	– 1,400
Total	7,000	1,400	– 5,600
Spare parts for machinery.—			
From United States ...	26,000	13,000	– 13,000
,, Great Britain ...	11,000	8,000	– 3,000
,, Other countries ...	5,000	2,000	– 3,000
Total	42,000	23,000	– 19,000

	1914. £	1915. £	Inc. or dec. £
Machinery (other than agricultural).—			
From Germany	40,000	9,000	– 31,000
,, United States ...	127,000	97,000	– 30,000
,, France	4,000	1,500	– 2,500
,, Great Britain ...	42,000	19,000	– 23,000
,, Italy	1,000	1,000	—
,, Other countries ...	5,000	2,500	– 2,500
Total	219,000	130,000	– 89,000
Railway and tramway cars.—			
From Germany	500	3,000	+ 2,500
,, United States ...	10,000	17,000	+ 7,000
,, Great Britain ...	3,000	1,000	– 2,000
,, Other countries ...	5,500*	1,000	– 4,500
Total	19,000	22,000	+ 3,000
Rails.—			
From United States ...	113,000	80,000	– 33,000
,, Germany	1,000	10,000	+ 9,000
,, Great Britain ...	9,000	—	– 9,000
,, Other countries ...	32,000*	2,000	– 30,000
Total	155,000	92,000	– 63,000

* Belgium.

* Belgium £32,000.

BUSINESS NOTES.

Book Notices.—"Theory of the Submarine Telegraph and Telephone Cable." By Dr. H. W. Malcolm. London: The *Electrician* P. and P. Co., Ltd. Price 18s. net.

"Engineering Directory." No. 64. July, 1917. London: Engineering, Ltd.

"Laws of Physical Science." By Dr. E. F. Northrup. London: J. B. Lippincott & Co. Price 8s. 6d. net.

Brazil.—The American Consul at Rio Grande, Rio Grande do Sul, states that the importation and distribution of foreign merchandise in the State of Rio Grande do Sul have been controlled chiefly by German houses, which endeavour to import everything possible from Germany. "In the electrical line this was particularly true, but, in spite of this handicap, several American electrical articles found their way to the market solely because of their superiority. There are some 45 electric light and power companies furnishing service in the various municipalities of this State, and there is a constant demand for plain lamps, fixtures, fans, small motors, and supplies. The trade is principally in the hands of the hardware dealers, all of whom carry some electrical equipment, and certain ones make a speciality of electrical goods. Certain electrical specialities are sold in drug stores and even by the larger general stores, but, as a rule, greater effort is put forth by the hardware dealers making a speciality of these lines. American electrical irons, toasters, warming pads, &c., could find an increased sale through intelligent sales methods, which would include correspondence with the dealers conducted in Portuguese, or at least in Spanish." Attractive literature should be sent at once, stating terms and giving data showing volume and weight of goods packed for export. "Three months are often required for a reply from this section of Brazil, and it is best to give at once all possible information. In the distribution of electrical goods generally, it is better for exporters to deal directly with the importers, and not place all chances of success or failure in the hands of a general agent."

For Sale.—The Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board has for disposal 90 Reason maximum-demand indicators. Particulars are given in our advertisement pages to-day.

The Assets Auctions Co. will sell by auction, on September 13th, at 129, Newington Causeway, the stock of an electrical factor. For further particulars see our advertisement pages to-day.

The Rochdale Corporation Electricity Committee has for disposal one Belliss-Morcom-B.T.H. 220-kw., three-phase, 3,000-volt steam alternator. For particulars see our advertisement pages to-day.

Kilmarnock Corporation has for sale one complete D.C. switchboard for lighting and traction. For particulars see our advertisement pages to-day.

Catalogues and Lists.—British Thomson-Houston Co., Ltd., Rugby.—List No. 3,313 (20 pages) contains illustrated details of their truck type ironclad switchgear, type T, forms A and B for polyphase systems up to 11,000 volts. Half-tone illustrations, outline drawings, and diagrams of connections occupy a large amount of space.

The Benjamin Electric Co., Ltd., 1a, Rosebery Avenue, London, E.C.—Leaflet giving illustrated description and prices of their industrial signals or interior factory calling systems for fire alarms, air raid, and general service purposes.

Messrs. L. Andrew & Co., 2, Whitworth Street West, Deansgate, Manchester.—Net wholesale price circular of india-rubber gloves and gauntlets.

Fire.—Press reports state that the premises of Bradbury and Co., manufacturers of electric light fittings, of Woodcock Street, Birmingham, were gutted by fire on Tuesday morning.

Liquidation.—Feld Bros. & Co., Ltd.—The Controller, Mr. J. E. Percival, has applied for his release.

Trade Announcements.—Messrs. Quead, Ltd., have appointed the Western Electric Co., Ltd., of 49, West Campbell Street, Glasgow, as sole agents for the sale of their patent "Quead" fires in Scotland.

The Brush Electrical Engineering Co., Ltd., have removed from No. 1, Kingsway, to Maxwell House, Arundel Street, Strand, London, W.C. 2.

LIGHTING AND POWER NOTES.

Aberdeen.—Year's Working.—The annual report by the Corporation electrical engineer, Mr. J. A. Bell, states that the total income for the year to July 31st was £76,369, an increase of £496, while the total working expenses amounted to £47,215, an increase of £8,035. The gross profits amounted to £29,153, a decrease of £7,539. There was a deficit on the year's working, which was taken from the reserve fund, now standing at £39,304, of £345. Summer Time, early shop closing, and lighting restrictions have reduced the revenue by £1,076, and a reduction of 5 per cent. on the previous year's charges, has reduced the revenue £1,192 for lighting, £1,162 for power and heating, which reductions have been counterbalanced by the increase in sales for power. Mr. Bell explains that, owing to the war, the advance in power uses has been on a scale never experienced before.

Bolton.—The electrical engineer (Mr. W. J. H. Wood), at the request of the Coal Controller, is to co-operate with Mr. J. A. Robertson, as local representative for the South Lancashire and Cheshire districts with a view to securing economy in the consumption of coal.

Canada.—Ontario Hydro-Electric Proposals.—In a recent letter to the *Electrical World*, Mr. R. P. Bolton discusses the financial possibilities of the Ontario Hydro-Electric Commission's acquisition of the Ontario Power Co., which was rendered necessary by the proposed power development at Queenston by the Commissioners. The water which the Power Co. used provided a development of 180,000 H.P. on a fall of 160 ft., and the same volume of water at Queenston, with a head of 310 ft., will develop about 390,000 water H.P., or 300,000 electrical H.P., at an estimated cost of $50 per electrical H.P. But the new development will still be burdened by the investment on the existing plant, and Mr. Bolton considers that the cost of the Queenston project added thereto will still leave the figure at $126 per H.P., which is that of the Ontario Co.'s property. He calculates that the operating and fixed charges will amount to $16·57 per H.P., which is greatly in excess of the price at which the Commission has hitherto purchased its service.

According to the *Financier*, the Imperial Privy Council has granted leave to the Electrical Development Co. to appeal against the decision of the Ontario Courts denying the company the right to proceed against the Attorney-General of the Province and the Hydro-Electric Commission with regard to the contemplated Chippewa development. The Electrical Development Co. contends that the original franchise given by the Government stipulated that it would never take water from the Niagara or Welland Rivers (Chippewa River) to compete against the company. It is suggested that if this covenant is binding, it would apply as much to the taking of water through the works of the Ontario Power Co. as in any other way. The Chippewa power plant would provide a development of 500,000 or 600,000 H.P., at a cost of about $30,000,000.

Cardiff.—Linking-up.—The electrical engineer and manager has submitted a report on the question of linking-up the various power stations in the South Wales area, in connection with which a Committee has been formed, of which he has been appointed chairman. He asked for the authority of the Electricity Committee to go more closely into the question of details, including estimates of cost, &c., in order that the same might be submitted at a later date to this Committee for consideration, and at which time it is intended that the Committees of the various local undertakings should appoint representatives to meet together to finally discuss the matter. The Committee agreed to this, and will contribute to the united Committee similarly to other electrical undertakings on the basis of their annual revenue, the amount of the subscription for the Cardiff undertaking being £10.

Colne.—Salaries.—The T.C. has decided to give the Corporation officials a war bonus of £25 per annum. When the war commenced it was decided to leave over the question of increases of salary, but it was felt that, as most workmen were now in receipt of more or less substantial war bonuses, the officials should also be granted a contribution towards the increased cost of living.

Continental.—France.—La Société des Forces Motrices de la Truyère is the name of a new company which has just been formed in Paris with a capital of £600,000, to establish a large hydro-electric plant to utilise the water power of the River

Truyère, the Société des Mines de Bruay, and the Société des Forges de Chatillon-Commentry-Neuves Maisons are interested in the new undertaking, the main object of which is to supply the electrical energy required for the new electric steel plant which is at present in course of construction by the Chatillon-Commentry Co. It is stated that the hydro-electric plant to be established will have a capacity of 36,000 H.P.

Spain.—Following the experiments at its Marie Luise Pits, it is reported that the Sociedad Metalurgica Duro-Felguera has decided to adopt underground electric traction in the whole of its collieries.

Italy.—According to the American Consul, in the City of Venice there are over 1,200 users of electric light and over 1,000 users of electric power. Electricity is generated by water power, and as coal is scarce and high in price the number of power users is large everywhere in the Veneto, and is constantly increasing.

According to a paragraph in *L'Economista d'Italia* for August 25th, the Municipality of Turin has under consideration a large new hydro-electric station in Valle dell 'Orco. The scheme will comprise (1) the construction of two barrages on Lakes Serru and Agnel, in the valley, capable of storing 7 million cubic metres of water, and a branch on the Ceresole plain, on the left slope, of an average capacity of 2,200 litres, with a minimum of 1,450 litres; (2) a barrage on the Telessie plain and Lakes Balma and Eugio, to form a basin of 15 million cubic metres; (3) a branch, from the Valle dell 'Orco to the Valle della Centrale del Rossone, on the left bank, where all the water from higher up will be collected. According to estimates received, the new installation will give 20,000 KW., and will cost 40,740,000 lire (£1,629,600).

Dublin.—At a meeting of the Corporation, last week, objection was taken by Mr. Moran to certain extra payments to employés of the city electricity department. Mr. P. T. Daly said it was curious that two men were always mentioned as having done the overtime. Mr. Sherlock stated that some members thought the men referred to were favoured by the chief engineer because they were associated with him in other matters. Alderman Farrell declared that, in his opinion, Mr. Ruddle was not a free man; some of the officials even threatened him in his office. The paragraphs relating to overtime payments were deleted.

Dundalk.—The Urban Council has adopted a report of the Electricity Committee, in which it was stated that a satisfactory settlement had been arrived at in the arbitration on matters in dispute with Messrs. Brook, Hirst & Co., contractors for a new switchboard in connection with the supply meters at the Great Northern Railway (Ireland) sub-station. The contractors had agreed in each matter, and had, in addition, paid the arbitration expenses.

Fife.—Steel Furnaces.—A 5,000-H.P. steam turbo-generating set has just been installed at the works of the National Steel Foundry (1914), Ltd., at Leven, to supply the current for the electric steel melting furnaces, and for other purposes. The company has at present two electric steel furnaces, one being of the Snyder, and the other of the Heroult type; a third furnace is, however, in course of erection, and is expected to be in operation at an early date.

Glasgow.—Year's Working.—The twenty-fifth annual report of the Corporation electricity undertaking, for the year ended May 31st, 1917, shows a gross revenue amounting to £580,433, and working expenditure to £404,404, leaving a gross profit of £176,029; interest, £83,039, sinking fund, £76,049, and depreciation, £55,606, absorbed £214,695, leaving a deficit on the year's operations of £38,666, to meet which a sum has been transferred from the reserve fund account, which now stands at £19,172. The revenue account shows an increase of £49,713, but the working expenses have increased by £81,752, due apart from the larger output to the increased price of coal, materials and workmen's wages: £5,885 has been paid to dependents of employés on active service.

Capital expenditure during the year amounted to £255,353, and the total capital expenditure at the end of the year, less depreciation written off, stood at £2,835,297; the total depreciation written off the capital account to May 31st amounts to £766,915. The consumers at May 31st last numbered 34,724, as compared with 33,605 in the previous year. The total units generated were 162,398,668, including 5,139,217 purchased from the tramway department; the total units sold were 141,196,627, as compared with 112,794,461 in 1916. The units sold to private consumers were 140,513,680, an increase of 30,025,058, equal to 27·17 per cent.; of these, 20,474,183 units were for lighting, and 120,039,497 for power. The total number of motors connected was 12,401 of 97,733 H.P., and the units consumed amounted to 117,547,855, as compared with 11,472 motors of 84,744 H.P. and 88,596,457 units in the previous year. The total connected load was 123,180 KW., as compared with 109,370 KW.; and the maximum demand on December 21st last was 49,185 KW.

The report states that the foundation contract and river work of the new Dalmarnock works is now practically completed, and that plans and specifications were shortly to be issued for the buildings, boiler house, turbine room and switch house, and that permission has been obtained for orders being placed for two 15,000-KW. turbo-alternators and necessary boilers. It is hoped that a third 8,000-KW. turbine set will be ready for this winter at Port Dundas station, bringing up its capacity to 46,600 H.P.; a similar sized turbine has been supplied to Pollockshaws Road station, making the plant capacity 37,000 KW. The Govan and Partick plants represent 4,450 H.P. and 2,650 H.P. respectively.

Contracts have been entered into for the supply of coal for the coming year at practically the same price as in the year just closed.

The Committee recommends that the charges for electrical energy as from the date of last survey of the financial year 1916-17, and until further notice, be:—For private lighting in shops, warehouses, theatres, &c., 5d. and 1½d.; domestic lighting, 4½d.; for power, 2d. and 1d. per unit, 500,000 units and over, 1½d. for the first 250,000 units, and ¾d. for the second 250,000 units; special supply, 1d. and ¾d. per unit. Heating, other than domestic, 1½d. per unit; special rate to domestic consumers, 1d. per unit; where a special meter is to be installed for heating or cooking supply, 1½d. per unit; the KW. charge to be increased by 15 per cent. plus a running charge, which will vary with the price of coal.

Hebden Bridge.—Bulk Supply.—The U.D.C. has made an agreement with the Halifax Corporation for the supply of electricity in bulk to Hebden Bridge for a period of seven years from September 9th. The Corporation is to supply all mains, plant, and apparatus, and the Council is to carry out the laying of the cable between the Corporation's existing station and the Council's electricity works.

Hove.—Price Increase.—From September 30th the charges for current for power will be increased to 2d. per unit on the flat rate and by 10 per cent. on the indicator rates of charge.

Ireland.—The rising cost of illuminants is again drawing attention to the advantages of electricity and its cheapness when water power can be had on the spot. Few countries are more favoured with rivers and streams, and the wonder is that such power is left untapped in so many places, particularly in the south and west, where many towns and villages are built on rivers, &c. Another matter for wonder is that there is not more propaganda on the advantages of electrical lighting.

London.—Deptford.—The General Purposes Committee reports that a letter has been received from the Clerk of the L.C.C. referring to the question of the electricity supply of London. The County Council now suggests that a further Conference should be held, and in this connection the Clerk states that he presumes that if a Committee exists, this Council would wish to be represented at the further Conference by such Committee, and not by individuals. As a matter of fact, the Councils not owning electricity undertakings have not appointed a representative Committee.

Maidstone.—Year's Working.—The report of Mr. Hoadley, the borough electrical engineer, on the electricity undertaking for the year ended March 31st last, shows that the total revenue amounted to £22,736, the total costs to £14,463, and the gross profit to £8,273—these figures comparing with £19,771, £13,532, and £6,239 respectively in the previous year, while the net result after meeting capital charges was a profit of £1,186, as against a loss of £256 in 1916. The output sold was 3,236,741 units, as against 2,753,788 units in 1916; power supply absorbed 2,435,033 units, an increase of roughly 460,000, while heating and cooking supply more than doubled. With this respectable increase in the day load (the lighting load fell off at the same time), the load factor improved to 29·6 per cent., and the working conditions were further improved by the use of a Ljungstrom turbine plant, so that the total operating costs fell from 1·075d. to ·995d. per unit (coal cost falling from ·604d. to ·589d.). Had not technical difficulties with a converter plant interfered with the continuous use of this turbine, the savings would have been much greater. The connected load was 117,780 equivalent 30-watt lamps and the maximum load 1,246 KW. The gross profit amounted to 13·6 per cent. on the outstanding capital.

Mexico.—Taxes on Electric Light and Power.—H.M. Chargé des Archives at Mexico City reports that as regards certain special stamp taxes imposed on, *inter alia*, electric lighting, a new arrangement has come into force, whereby the company supplying the service is responsible to the Government for a tax at the rate of 10 per cent. on the actual consumption, as shown on the bill of the consumer. This tax is to be collected by the company. Persons using not more than three lamps are exempt from the tax. No tax will be levied on signs and advertisements, special illuminations, charitable institutions and schools, public lighting, and federal and municipal buildings.

A tax on electric power has been fixed at 3 per cent. on the amount of the bill of the consumer. Exemptions from this tax are Government installations, power sold to other companies which are not consumers but who resell and distribute, and power supplied for irrigation and agricultural purposes.—*Board of Trade Journal.*

Newcastle-under-Lyme.—Year's Working.—For the year ended March 31st the Corporation electricity department had a revenue amounting to £3,435; the working expenditure was £1,972, and, after providing for financial charges amounting to £1,715, a deficit of £253 resulted. The total units sold were 225,880, as against 257,216 in the previous year; the maximum load was 177 KW.

New Zealand.—The Christchurch City Council has decided, in view of the Public Works Department being unable to meet the Council's increased demands for electricity during the next two years, on account of its inability to obtain the necessary plant to extend the Lake Coleridge generating station, to install a producer-gas stand-by plant, at a cost of several thousand pounds. The Department has been asked to pay a share of the cost, seeing that the outlay is necessitated by its inability to fulfil its contract to supply power.—*Otago Weekly.*

Shipley.—The U.D.C. has approved the advances in wages recommended by the Association of Engineers to the engineers in the electricity department. After consideration of a letter from the General Labourers' Union with regard to the wages of firers and switchboardmen, the Council agreed to alter the war-time payment of men employed 60 hours per week.

Stratford-on-Avon.—Proposed Price Increase.—The Electricity Co. has asked the T.C. for consent to a further increase in the price of current from 6d. to 6½d. per unit for the period of the war and 12 months after. The matter has been referred to a Special Committee for consideration.

Venezuela.—An American Consul states that the Maracaibo Electric Light Co., which started operation in 1888, is now furnishing electric power during the daytime. The capacity of the plant has been increased fourfold during the last two years. During the same time the company introduced the United States standard three-phase, 60-cycle system, with standard voltages. An American is the chief engineer for the plant. In view of the fact that electric power is now being furnished during the day, it appears there will be good opportunity for the sale of electric motors for industrial purposes. No large motors will, however, be required. Gradually, no doubt, there will be developed a demand for electric fans. Opportunities for the sale of electric heating and cleaning appliances do not appear favourable at present.

Wrexham.—Price Increase.—The T.C. has increased the charges for current for lighting and heating by another 15 per cent., making a total increase during the war of 25 per cent., and for power by 6¼ per cent., making a total advance of 16¼ per cent.

TRAMWAY AND RAILWAY NOTES.

Birkenhead.—Year's Working.—The working of the Corporation tramways for the year ended March 31st last resulted in a total revenue of £80,748, an increase of £7,926 over the previous year; the working expenses amounted to £42,106, leaving a gross profit £38,641, and, after making provision for interest, sinking fund, and income-tax, &c., of £24,989, the net balance remaining is £13,652, an increase of £3,082 on 1916. The balance has been allocated as follows:—In aid of rates, £2,820; to reserve fund, £5,000; and to renewals fund, £5,832. The credit to reserve fund now stands at £8,192, and to renewals at £34,338. The car-mileage was 1,186,186, as against 1,176,951 in the previous year, and the passengers numbered 17,950,433, as against 16,676,022 in 1916.

Lancashire.—Tramway Wages.—The application of the Lancashire and Cheshire Tramway Workers for an advance in wages was considered at a conference in Manchester on Friday, August 31st, of the Lancashire and Cheshire Tramway Federation. It was decided to refer the question to the Committee on Production.

The Manchester Corporation and its employés have already agreed to a similar reference, and it is understood that a joint arbitration will be held for the whole of Lancashire and Cheshire.

Peru.—The Lima electric railway system is operated by the Empresas Electricas Asocindas, a company combining the three previous railway companies, which operated cars in Lima, between Lima and Chorillos (8 miles), and between Lima and Callao (9 miles); the old English line between Chorillos and Callao, *via* Lima, is worked for goods traffic. Altogether some 75 miles of single track, 135 passenger cars, and six electric locomotives are operated.—*Electric Railway Journal.*

Kingston-on-Thames.—Accident.—On Saturday morning, last week, a car belonging to the London United Tramways Co., while descending Kingston Hill, left the track and crossed the road, knocking down a tree and the iron standard supporting the overhead work. The collision with the standard caused the car to swing right round, the top being torn off and the body smashed; the only passenger, a lady, was injured about the head, and the driver was also hurt; the conductress was so seriously injured that she was detained at the Kingston Infirmary.

Preston.—Year's Working.—The revenue account of the Corporation Tramways for the past year shows a gross working surplus of £21,746, as compared with £20,131 and £17,483 in the two preceding years. The traffic receipts have risen from £45,618 in 1913-14 to £57,683 last year, but working expenses, including allowances to employés on war service, show an increase of £6,444 over the year just quoted, whilst the increase during the past year has been £4,827. The power expenses alone are £1,950 greater than in the previous year.

Newcastle.—The City Council has approved of air raid warnings at night being given by interrupting the tramway supply for a minute, and after resuming supply, finally cutting it off. During the day, current will be cut off and a red flag displayed on each car.

Year's Working.—At a meeting of the Corporation Tramways Committee, the annual financial statement of the undertaking was submitted. The total revenue of the tramways for the year ended March 31st last was £356,534, an increase on the previous year of £31,840; the total working expenses were £208,299, compared with £192,648.

Deducting working expenses, there was a sum available of £148,236, compared with £132,046 for the previous year; interest on investments, &c., brought the total available to £154,619, which was equivalent to 43 per cent. of the gross receipts. Out of the last-named sum the following charges had been met:—Allowances to the dependents of men on service, £15,939; special rents, £1,541; interest on capital, £26,776; redemption of debt, £46,009; interest on old horse tramway loans, £1,449; making a total of £91,716. The balance has been appropriated thus:—Income-tax, £15,845; contribution in aid of rates, £7,000; insurance (third party) reserve, £2,065; renewals fund, £37,992. The sum transferred to the renewals fund was £14,132 larger than in the previous year. Owing to the fact that labour and materials had been difficult to obtain, the repairs and renewals to the permanent way had not been carried on as in former years, consequently only the sum of £9,562 had been spent during the year, being £11,490 less than was spent in 1916.

Mr. R. Mayne, the chairman, in moving the adoption of the report, said it was satisfactory to note, in view of the heavy expenditure which would be required in the future, that there was now practically £106,000 in the reserve and renewals fund. The cost of renewals for some years to come would be considerably heavier than in pre-war times, and it would be advisable to appropriate the whole of the present year's surplus to that purpose. Every endeavour would be made to carry on the undertaking without having recourse to increasing the fares, and it was to be hoped that the traffic returns would be such as to avoid having to make any alteration to the existing fares and stages.

Rawtenstall.—Strike.—The employés of the Corporation tramways ceased work on Sunday and Monday last, owing to a dispute in regard to the war bonuses paid to women and boys, causing considerable inconvenience to local holiday makers.

Sydney.—City Railway.—The N.S.W. Cabinet has decided to discontinue the work of constructing the city railway; all work is to be immediately closed down, except such as is necessary to remove the obstruction in Macquaree Street. In making this announcement, Mr. Fuller stated that whatever loan money might be available in the near future for the Railway Department would be devoted to the construction of rolling stock necessary duplications, and to carrying to completion such lines of a revenue-producing nature as had already been started.—*Sydney Daily Telegraph.*

According to the *Sydney Morning Herald*, in the first year of the war practically seven millions was expended on the project, in the second year over eight millions, and in the third, which ended on June 30th last, about seven millions.

Wolverhampton.—The temporary suspension from time to time of the Corporation tramways was explained by Mr. S. T. Allen, the borough electrical engineer, as due to increased demand for electricity on the part of the factories in the town and delay in obtaining the use of new plant which has been ordered and has not yet been completed. It is hoped, with economy on the part of the consumers, to keep the supply going until the first of the new generating sets now being completed is running.

TELEGRAPH AND TELEPHONE NOTES.

Italy.—A powerful wireless station is being erected with all speed at the instance of the Ministry of Marine in a spot in central Italy unnamed. The station, says *l'Elettrotecnica*, will be built and equipped on a new system, radically different from those constructed hitherto by the larger European wireless installation companies. The latest types of American transmitting and receiving apparatus will be installed, under the special supervision of the Minister of Marine. The opening of the station is expected to take place shortly, thus constituting a record for speed of construction.

Damage to Insulators.—At Blackburn County Police Court, on August 30th, three youths were summoned for unlawfully and maliciously breaking an insulator on a telegraph pole at Mellor. Cornelius Coward, of Preston, Inspector of Telegraphs, stated that in his area, which covered a radius of 18 miles from Preston, there had been considerable damage this year. No fewer than 3,000 insulators had been broken, representing about £520. On the road in question, which carried nothing but trunk wires, which were used for important war work, 178 insulators had been broken, representing over £31. Defendants, who denied the offence, were each fined 10s., and ordered to pay 4s. 6d. each expenses.

Denmark.—U.S. Consul-General Winslow reports that the total earnings of the State telegraph and telephone systems in 1916 were about $1,800,000, the telegraphs accounting for $1,175,000. Maintenance, salaries, &c., totalled $1,170,000, leaving a net profit to the State of about 18 per cent. on the capital invested.

Norwegian Wireless Station.—A wireless station is in course of erection, with a view to opening communication with America. The station, which is near Stavanger, will have its receiving station at Nærbo. The contractors are pledged to hand it over for working within the current year.—*Den Tekniske Forenings Tidskrift.*

Portugal.—The postal and telegraph services have been temporarily deranged by a strike of officials. The Government has decreed that the entire staff of the departments is incorporated in the army, and that absentees will be treated as deserters, and the situation is now normal.

Spain.—By a Royal Decree, bearing date June 8th, all private existing and projected wireless stations transmitting and receiving, or receiving only, for whatever purpose used, are made subject to Government inspection. The inspection will be carried out by officials of the Telegraph Department, and its objects are to watch over public interests and order, to safeguard the State wireless system, and the fulfilment of the stipulations regarding material and the terms of concessions. Breaches of the regulations will be followed, in minor cases, by fines, or, in the graver cases, by the confiscation of the concession and plant and a heavy fine.—*La Energia Electrica.*

Sweden.—A Commission has been appointed to arrange for the erection of a wireless station at Karlsberg, which is to communicate with other international systems.

Telephone Directory.—Owing to the scarcity of paper and labour, it has been decided to defer the next issue of the Telephone Directory for three months, until January, 1918, and to publish two subsequent issues at nine-month intervals, in October, 1918, and July, 1919.

CONTRACTS OPEN AND CLOSED.

OPEN.

Australia.—Melbourne.—October 10th. Department of the Navy. Pumping plant and equipment for the Commonwealth Naval Dockyard, Cockatoo Island, Sydney. Specifications from the Director of Navy Contracts, Melbourne.

Dublin.—September 11th. Electricity Supply Committee. Twelve months' supply of cables, troughing, bends, section pillars, service boxes, &c. See "Official Notices" August 31st.

London.—Bermondsey.—Sept. 7th. B.C. 500-kw. rotary converter. See "Official Notices" August 3rd.

Manchester.—September 17th. B. of G. Installation of a telephone system at the offices, All Saints. Particulars from Mr. J. Macdonald, Clerk.

Spain.—The municipal authorities of Castrillo de Villavego (Province of Palencia) have lately invited tenders for the concession for the electric lighting of the town during a period of six years.

Stockton-on-Tees.—September 10th. District Fund Gas and Electricity Committees. Stores, &c., for six months. See "Official Notices" August 31st.

CLOSED.

Cootehill (Co. Cavan).—Urban Council. Generator (35 lights), £40: Mr. Robert Coyle.

Manchester.—Electricity Committee. Accepted tenders:

Superheater tubes, &c.—Babcock & Wilcox, Ltd.
Lea recorders.—Lea Recorder Co., Ltd.

Salford.—T.C. Accepted tenders:—

Edison's Electric Accumulators, Ltd.—Two-ton electric vehicle with automatic tipping body, £1,129.
W. T. Glover & Co.—Low-tension, paper-insulated, lead-covered cable, £177.
British Westinghouse Co.—One 300-kw. rotary converter set, £1,535; switchgear, £551.
Ferranti, Ltd.—One 250-k.v.a., three-phase, oil-cooled power transformer, £274.

FORTHCOMING EVENTS.

Birmingham and District Electric Club.—Saturday, September 8th. At 7 p.m. At the Swan Hotel, New Street. Paper on "The Manufacture of Commutators for Electrical Machinery," by Mr. A. F. Green.

Salford Technical and Engineering Association.—Saturday, September 8th. At 7 p.m. At the Royal Technical Institute, Peel Park. Paper on "Transmission of Power by Chains," by Mr. H. T. Hildage.

Theft.—On a charge of stealing a quantity of electrical appliances, fittings, and tools, valued at £100, Jesse Taylor (17), electrical test assistant, employed by the Chloride Electrical Storage Co., Clifton Junction, was bound over at the Manchester Police Court on Friday last.

NOTES.

Legal.—Price *v.* Hook.—In the City of London Court, on Tuesday, before his Honour Judge Atherley-Jones, K.C., a claim was made by Mr. Charles E. Price, accountant's clerk, against Mr. Charles Hook, trading as the Times Electric Co., Ltd., electrical manufacturers, Godliman Street, E.C., to recover the sum of £32 for balance of salary and for services as a book-keeper and secretary of the company, as well as a claim for a bonus. Mr. Griffiths appeared for the plaintiff, and Mr. Valetta for the defendants. Mr. Griffiths said that the defendant was the owner of a one-man company. There was nobody in it except the defendant and his wife. Mr. Valetta said that the plaintiff had no business to have sued the defendant. It was the Times Electric Co., Ltd., which employed the plaintiff, and not Mr. Hook.

The plaintiff, in his evidence, stated that he had been in the employment of the defendant for five or six years as book-keeper. Then Mr. Hook turned his business into a limited company. He was paid £3 monthly as book-keeper, having other employment elsewhere, and retained the position of book-keeper until August, 1916, when one of the two directors was called up for military service. The other director had been secretary, and witness took the post of secretary at £1 a week, in addition to his remuneration as book-keeper. There was now £32 due to him as the balance for the service which he had rendered. It was distinctly agreed that he was to be paid a bonus at the end of each financial year as might be decided by the directors, but the figure was not to be fixed until it had been seen what the profits were. The company made a very large profit this year, but last year there was a loss. He was not claiming for a floating bonus, but only for the minimum bonus which was agreed between them. In cross-examination, witness said Mr. Hook held 998 shares out of 1,000 which had been issued. He certainly had no intention of making Mr. Hook personally liable, except that Mr. Hook was the company.

Mr. Valetta urged that the action could not succeed against the defendant personally, and the company was not before the Court. The company had sued the plaintiff in another action to be heard in a fortnight's time for the return of books belonging to the company and £5 lent to the plaintiff. Judge Atherley-Jones suggested that the proper thing to do was to amend the summons by adding the company. Mr. Valetta objected to that, and said there was no justification whatever for the present action. Judge Atherley-Jones, K.C., was afraid plaintiff could not proceed, but he thought the defendants had misled the plaintiff in applying for particulars, and so treating the action as properly brought against Mr. Hook. There must be judgment for the defendant, but without costs, which he thought he was justified in doing, having regard to the course pursued by the defendants.

Gas Topics.—The *Times* recently drew attention to the drastic German restrictions on gas consumption. All over Germany this reduction was to equal 10 per cent. of the monthly consumption a year ago, but in Berlin new orders have been issued which, it is estimated, will reduce ordinary domestic gas consumption by a half. In view of the coming winter, this restriction, together with the reduction in coal heating, has raised a strong public protest.

The Taunton Gas Co. attributes to the lighting restrictions and the Summer Time Act a decrease in consumption of five million cubic feet during the year.

At one of the Sheffield gas works an explosion recently occurred, in which 20 persons were injured. The explosion originated in a meter house where repairs were being made and set fire to a gas-holder, which was burnt out, while a second holder was wrecked by flying fragments.

Educational Notes.—Hackney Institute (L.C.C.).—The new session opens on September 17th, with evening lecture and laboratory courses in electrical engineering subjects, including electrical measurements, dynamos and motors. An announcement appears in our advertisement pages to-day.

University College, London.—The programme for the new session in the Faculty of Engineering has been issued, giving particulars of the courses of study, scholarships, fees, &c. Prof. J. A. Fleming is head of the Department of Electrical Engineering.

Appointments Vacant.—Overhead lineman (40s. +), for the Colne Corporation Light Railways; electrical fitter, for the South Lancashire Tramways Co.; junior assistant to shift engineer (£91), for the Worcester Corporation electricity works; electrical staff for the ordnance depôts, aerodromes, and military camps in the Southern Command; draughtsman, for the Borough of Hornsey electricity works; two engineers to take charge of shifts (55s.), for the City of Hereford electricity works. See our advertisement pages to-day.

Profit-Sharing.—In the September number of the *Financial Review of Reviews*, Mr. J. B. C. Kershaw has an article on "The Promotion of Industrial Efficiency," in which he discusses the question of profit-sharing as a means of bettering the position of the workers and increasing productivity. He expresses the opinion, which has frequently been stated by ourselves, that the amount of the bonus requires to be substantial in order to be of any practical help in satisfying demands. A bonus of 5·5 per cent. on wages can have little effect in raising the worker's efficiency or increasing his devotion to his employer's interests. A German firm found nothing under 10 per cent. to be of any value; the Lever maximum is 20 per cent., but the author is of opinion that 30 per cent. or 40 per cent. on standard wages would, in many

cases, be justified by the results. He discusses the investment of the bonus, and, briefly, the subject of welfare work. Profit-sharing is more easily applicable and more readily accepted as part of a scheme of industrial partnership in which the general welfare of the workers is also reasonably and fairly provided for.

Institution and Lecture Notes.—The Institute of Metals.—The annual autumn meeting will be held on Wednesday, September 19th, at Burlington House, Piccadilly. At the opening session (4 p.m. to 6.30 p.m.) the following communications will be presented:—

"Experiments on the Fatigue of Brasses." By B. Parker Haigh, D.Sc.
"Hardness and Hardening." By Prof. T. Turner, M.Sc.
"The Effects of Heat at Various Temperatures on the Rate of Softening of Cold-rolled Aluminium Sheet." By Prof. H. C. H. Carpenter, M.A., Ph.D., and L. Taverner.
Note on "A Comparison Screen for Brass." By O. W. Ellis, M.Sc.

At the evening session (from 8 p.m. 10 p.m.) the proceedings will include:—

"Further Notes on a High-temperature Thermostat." By J. L. Haughton, M.Sc., and D. Hanson, M.Sc.
"Principles and Methods of a New System of Gas Firing." By A. C. Ionides.
"Fuel Economy Possibilities in Brass-melting Furnaces." By L. C. Harvey.
"The Effect of Great Hydrostatic Pressure on the Physical Properties of Metals." By Professor Zay Jefferies, B.Sc.
Note on "The Use of Chromic Acid and Hydrogen Peroxide as an Etching Agent." By S. W. Miller.

In connection with Mr. Ionides's paper, a demonstration of a new system of furnace heating will be given, and it is expected that this paper will give rise to an animated discussion on metal melting.

Invitations to be present at the meeting can be obtained by non-members of the Institute of Metals on application being made to Mr. G. Shaw Scott, M.Sc., secretary and editor, 36, Victoria Street, S.W. 1, from whom also particulars of the forthcoming ballot for the election of new members can be obtained. So great is the present interest in metallurgical matters, that the membership of the Institute has increased, we are informed, since January 1st last by over 30 per cent.

Junior Institution of Engineers.—This Institution has instituted a "Cadet Associate Membership," whereby engineering pupils in works or college (day or evening students) may be registered for a nominal yearly fee of 5s. It is open to youths of 15 years and over who are still undergoing training, and who, as certified by a principal of a technical college or head of department of an engineering works, are making satisfactory progress in the development of their abilities as engineer pupils. The registration as a Cadet Associate Member of the J.I.E. is for one year only, and renewals can only be accepted when satisfactory progress and development is vouched for by a responsible authority under whom the applicant is serving. The Institution undertakes certain duties in regard to these Cadets, which are set forth in a pamphlet which may be obtained upon application to the Secretary, Junior Institution of Engineers, 39, Victoria Street, Westminster, S.W. 1. The project is commendable, and will, doubtless, meet with the success it deserves. There is little doubt that much valuable *personnel* is now wasted for the lack of a wider organisation such as the Juniors can furnish, and the constitution of the Council is such that the new scheme will be pushed with vigour and enthusiasm in the interests of the profession and of patriotism. Many youths feel that they wish to become engineers, but drift into other professions where they are round pegs in square holes, simply because there is no one from whom they can claim assistance and advice in the furtherance of their desires. Many apprentices, too, remain unacquainted till too late with openings which might lead to their advancement in public or private services either at home or abroad. Managers of engineering shops throughout the country are frequently in need of youths possessing certain elementary qualifications which local conditions cannot provide. Technical instructors, too, desire to become acquainted with openings in works, so that their pupils may gain a good start in life, and not be entirely dependent upon the blind god "chance," which has detrimentally affected the careers of numerous promising youths.

For Government Purposes.—A Scottish correspondent writes:—"Recently five houses in Buckingham Terrace, Edinburgh, were leased for a department of the National Insurance Commission, and alterations, including substitution of electric light fittings for gas, were carried out. Then in a short time the premises were vacated, and had to be put back to their original condition and the electric light fittings removed, at a cost of £3,000. Now, it is stated, the premises have been once more requisitioned for Government purposes, but it is explained that a stricter economy will now be observed."

Royal Mint Report.—The production of Imperial coins, viz., 203 millions, for the year 1915, exceeded by 16 millions that of any previous year, and precluded any but a comparatively small coinage (3 million pieces) being undertaken for Colonial use. Of the Imperial coinage 22 million pieces were gold, 105 million silver, and 76 million bronze. The Deputy Master, Sir Thomas Elliott, states that the silver issues were more than double that of any previous year, and were due to large demands consequent on the withdrawal of gold coin from active circulation. The profit on the year's working was £4,710,000. During the year, Sir Edward Rigg, Superintendent of the Operative Department, reports that 2,130 tons of metal were converted into coinage bars, this figure being approximately double the average of the previous 10 years. In the machinery branch the staff was considerably augmented and engaged on special work undertaken by the Mint. To meet the generally increased demands a 200-kw. Siemens-Belliss generating set was installed, and the main switchboard extended and re-arranged. The monthly output of the Mint generators averaged 42,269 units, an increase of 2,000 on the figure for 1914. The number of motors in use rose from 106 to 125, their gross H.P. being now 974. The extended use of high-power incandescent lamps has raised the total of such from 8 to 22, and the number of arc and flame lamps has been correspondingly reduced. Incandescent lamps in the official premises show an increase of 32, their total being 1,330, and those in the private residences number 135. In the Inland Revenue Department, 1 copper, 88 nickel, and 55 steel-faced electros were grown in connection with the preparation of adhesive, postcard and embossed plates and dies for postage and other stamps.

The Assayer of the Ottawa Branch Mint, Mr. R. Pearson, refers to experiments made with a view to the increase of the amount of gold electrolytically refined in a given time. Sufficient data were obtained to show that a current density of 7,250 amperes per sq. metre could be used, and a combination, at Ottawa, of the Miller's chlorination process and the electrolytic deposition of gold has been adopted with satisfactory results. Rough gold deposits which are reasonably "clean" (approximately 75 per cent. gold, 20 per cent. silver, and 5 per cent. base) may be raised to 980·0—990·0 fineness, cast into anodes, and the refining finished by the electrolytic process in 48 hours, all platinum and such metals being recovered from the electrolyte. The slimes are practically eliminated, the electrolyte does not become "foul," and need not be renewed for very long periods.

Volunteer Notes.—County of London Volunteer Engineers (Field Companies).—Headquarters, Balderton Street, Oxford Street, W. 1.

Orders for the week, by Lieut.-Colonel C. B. Clay, V.D., commanding:—
Officer for the Week.—Second Lieut. P. Bowden.
Monday, September 10th.—Technical instruction (searchlight) for No. 3 Company, Right Half Company, at Regency Street. Drill, No. 3 Company, Left Half Company. Signalling Class, 6.30. Recruits' Drill, 6.30.
Tuesday, September 11th.—Physical drill and bayonet fighting.
Wednesday, September 12th.—Drill and elementary bridge construction for No. 1 Company, Right Half Company.
Thursday, September 13th.—Drill and elementary bridge construction for No. 2 Company, Right Half Company. Signalling Class, 6.30. Ambulance Class, 6.30.
Friday, September 14th.—Technical instruction (searchlight) for No. 3 Company, Left Half Company, at Regency Street. Drill, No. 3 Company, Right Half Company. Recruits' Drill, 6.30.
Saturday, September 15th.—Commandant's Parade for route march and drill. Parade, Golder's Green Station, 2.45 p.m. Uniform. A and B men are reminded that one route march per month is compulsory. Recruits' drill, 2.30.
Uniform.—A and B men are warned to attend Headquarters on Tuesday, September 11th, to be measured by the regimental tailor for the Service Uniform.

(By order) Macleod Yearsley.

Power Sources of American Electric Railways.—A recent issue of the *Electric Railway Journal* contained a table showing that of 1,108 electric street railways and interurban lines, 54·3 per cent. generated their own power and the remainder purchased it, also that 70·6 per cent. of the cars are operated on generated power and 29·4 per cent. on purchased power. Many of the companies have power and lighting businesses in addition.

A further table giving a similar classification of railroads operating electrical divisions is as follows:—

Name and division.	Purchase power.	Generate power.	Motor cars.	Locomotives.	Miles.
Balto. and Ohio Belt Division	P	—	—	9	8·4
Boston and Maine, in New Hampshire	—	G	37	—	30·72
Boston and Maine, in Mass. ...	P	—	—	5	22
Bush Terminal R.R.	P	—	2	3	6
Chicago, Milwaukee, & St. Paul	P	—	—	44	440·6
Erie R.R., Rochester Division	P	—	8	—	40
Grand Trunk, St. Clair Tunnel	—	G	—	6	12
Great Northern Railway, Cascade Tunnel	P	—	—	4	10
Long I. R.R. Electric Division	P	—	591	—	217·2
N.Y., N.H., and H., all electrified divisions	P	G	25 44*	100	570
N.Y.C. and H.R. Elec. Div....	—	G	192* 19*	63	254·6
Norfolk Southern R.R. Va. Beach Division	—	G	25 17*	1	47
Norfolk and Western Railway	—	G	12	—	88·8
Penn. R.R., Paoli Division ...	P	—	93	—	96·6
Penn. Tunnel and Terminal Co.	—	G	68	66	95·5
West Jersey and Seashore R.R.	—	G	109	—	150·3

* Trailers.

A Tramway Conundrum.—A driver writes to us that he recently had occasion to use the electric brake (on a car fitted with a B.T.H. controller), and when on the third brake notch, the circuit-breaker tripped out and at the same time the car started again, as if working on the power notch, though the handle was still on the third brake notch. This was repeated several times, and our correspondent (who does not say what type of brake he was using) is anxious to obtain some explanation of the matter.

Prohibited Exports.—The Supplement to the *Board of Trade Journal* of September 6th contains complete lists of articles which, according to the latest information received by the Board of Trade, are prohibited to be exported from Norway, Portugal, Russia, Spain, Sweden and Switzerland. The Supplement also contains a reprint of the United Kingdom Contraband List in its present form.

Improved Motor Ambulances.—Two new types of motor ambulance specially designed to carry serious cases have been designed by the Motor Ambulance Department of the Joint War Committee of the British Red Cross Society.

One of the new vehicles is a single-bed ambulance. The body is light and airy with folding rear doors, and an electric radiant heater is used to maintain the necessary temperature.

The other vehicle is a special two-bed ambulance, built with duplex panels, between which is an insulating material. Heating is provided by electric footwarmers, the current for which is supplied by the regular lighting system on the car, and by pipes through which the whole of the exhaust of the engine can be taken. The car is scientifically ventilated and is lit by electricity. —*Times.*

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station and Tramway Officials.—Mr. Thos. Copp, permanent way foreman for the Peterborough Electric Traction Co., has been appointed permanent way inspector of the Cape Town Electric Tramways.

General.—Mr. R. Collins, who is at present on the Belfast staff of the Edison Swan Electric Co., Ltd., has been appointed engineer and manager of the Galway Electric Supply Co., in succession to Mr. I. E. Rayner, who is taking up an appointment in England.

Lord Rhondda has appointed Mr. John Wardle, commercial manager of the Metropolitan Railway, to control the cold air storage and inland transport of food.

Lieut. Jos. Martin, Northumberland Fusiliers, has been promoted to a Captaincy. When the war broke out he was an electrician at Newburn Steel Works, and enlisted as a private in the Fighting Fifth.

The *Times* states that the President of the Board of Trade has granted to Sir E. Wyldbore Smith, Director of the Commission Internationale de Ravitaillement, the rank of an Assistant Secretary to the Board of Trade so long as he holds his present appointment.

Councillor Peter Higson has been elected chairman of the Bolton Tramways Committee, in succession to the late Alderman Miles. Councillor J. R. Horrocks has been appointed vice-chairman.

Roll of Honour.—Captain William Gregory Terry, Lancashire Fusiliers, died of wounds in France on August 27th. He was educated at Shrewsbury School, and afterwards served his apprenticeship with Messrs. Browett, Lindley & Co., Ltd., Patricroft, going through the whole of the departments and completing his course in the drawing office. He afterwards joined the staff of the Salford Corporation electricity works, but after a few years he re-joined Messrs. Browett, Lindley & Co., Ltd., being appointed to their staff as outside representative of their Northern Section. Captain Terry was well known in engineering and colliery circles, and his genial manner won him many friends and respect everywhere.

Private C. Pollitt, Manchester Regiment, who has died in hospital, aged 47, was formerly employed by Messrs. Charles Macintosh & Co., Ltd., Manchester.

Private J. Kinsey, of the K.O. Royal Lancaster Regiment, who has been killed in action, was employed at the Blackpool Corporation electricity works.

Corporal W. Savage, Lancashire Fusiliers, killed in action, was employed by Messrs. Chas. Macintosh & Co., Ltd., of Manchester.

Second Lieut. Frederick Victor Claremont, R.G.A., late shift engineer at Islington electricity works, was killed in France on 14th ult.; Gunner G. Parker, R.F.A., who was previously employed at the same works as a boiler-house hand, was killed in action on July 14th.

Private F. Waywell, Lancashire Fusiliers, killed in action, was employed by Messrs. Charles Macintosh & Co., Ltd., electric wire and cable manufacturers, Manchester.

Corporal G. Luck, Manchester Regiment, killed in action, was employed by the British Westinghouse Co., Ltd., Trafford Park.

Gunner R. W. Aerstall, R.F.A., who is in hospital at Boulogne, after gassing, was employed by Messrs. Bottomley and Frampton, electrical engineers, Blackpool.

Lance-Corporal R. Rutty, N. Staffs. Regiment, whose death in action is reported, was before the war engaged at Siemens Bros. Dynamo Works at Stafford.

Private H. Thorp, 23rd French Mortar Battery, who has died of wounds, enlisted whilst second in charge of the dispatch department of the Ediswan Works, Ponder's End, where he was engaged for 25 years.

Staff-Sergeant A. Hardcastle, R.F.A., who was an electrician with Mr. T. Durrant, of Sheffield, has died in India from sunstroke.

Private S. Walton, Royal Scots Fusiliers, who has died of wounds, was an employé of Taylor, Tunnicliffe & Co., Hanley.

Private Wm. Toodgood, Gloucestershire Regiment, who has died in hospital at Bristol, was for three years on the staff at the Bath E.L. Works. In October, 1914, he was taken prisoner of war by the Germans, and some time ago he was repatriated, after enduring great hardship.

Rifleman F. Caswell, Rifle Brigade, who has fallen in action, was engaged at the Southwark Electricity Works.

Private E. Wallis, Queen's Royal West Surrey Regiment, who was with Crompton & Co., Ltd., Chelmsford, has been killed in action.

Rifleman A. Fricker, London Irish Rifles, who has fallen in action, was with the Telegraph Construction and Maintenance Co.

Lieut. L. A. Walker, Army Service Corps, whose death at the Front is announced, was resident engineer at Southgate for the Metropolitan Electric Power Co., Ltd. He had been recommended for the Military Cross.

Private W. L. Buckley, Royal Welsh Fusiliers, who has been killed in action, was on the staff at the generating station of the Leeds Tramways Department.

Sapper T. Grantham, of Blackpool, who is in hospital wounded for the fifth time, was an electrician at Blackpool Tower.

Second Lieut. E. B. Greenhouse, of Bishops Castle, who has been killed in action, was an engineer and electrician.

Private J. H. Oliver, R.E., who has been wounded, was apprenticed with Messrs. Lockart & McNab, electrical engineers, Upper Craigs.

Private R. C. E. Kerr, an employé of the Glasgow Corporation Electricity Department, has died from wounds, aged 35.

Corporal H. E. F. Gough, R.G.A., employed at the electricity works, Chester Street, Birmingham, has been killed in action.

Private T. Moody, an electrical engineer, of Knaresborough, was killed in action on August 10th.

Corporal William Dudley, Manchester Regiment, formerly reported wounded and missing, and now presumed to have been killed, was employed by the Record Electrical Co., of Manchester.

Obituary.—Mr. Walter Davenport.—We regret to note that there passed away at Egham, on August 28th, at the age of 73 years, Mr. Walter Davenport, who will be remembered by many in the electrical trade as the first secretary of the National Electrical Manufacturers' Association. Mr. Davenport, whom we always found a most genial and approachable man, was experienced in trade association matters by reason of his secretaryship of the Mineral Water and Vinegar Breweries' Association, and his experience proved very useful to the electrical industry when it was at the beginning of its organising efforts which preceded the larger operations of the B.E.A.M.A. Later he was, by virtue of his office in the N.E.M.A., prominently identified with electrical exhibitions held at Olympia and Manchester, and with the Electrical Trades Benevolent Institution. In recent years he had not been associated with electrical affairs.

Mr. J. G. Lorrain.—The *Times* "Deaths" column contains a notice of the death of Mr. James Grieve Lorrain, patent agent, of 9, John Street, Adelphi, W.C., which occurred at East Wittering suddenly on August 23rd. In the earlier years of his career he was closely connected with telephone developments in different parts of the British Isles. For considerably more than 30 years he had practised in London as a consulting engineer for electric lighting and telephone work, but more particularly as a patent agent. Mr. Lorrain was a member of the Institution of Electrical Engineers, a member of the Institution of Mechanical Engineers, and a Fellow of the Chartered Institute of Patent Agents. He was also a member of the Council of the Dynamicables. The deceased gentleman was well known in the electrical world, and his unassuming and kindly presence will be much missed in electrical and certain other Masonic circles in London, in which he was a prominent figure.

Alderman George Salter.—On August 31st there passed away suddenly, at the age of 61, at Stourbridge, Mr. George Salter, chairman of George Salter & Co., Ltd., steam gauge and spring makers, West Bromwich.

The death has taken place, at the age of 63 years, at Walton-on-the-Naze, of Mr. Archibald White, for many years chief engineer of the *Buccaneer*, owned by the India-Rubber, Gutta-Percha, and Telegraph Works Co., Ltd., Silvertown. He joined the company in 1898. Mr. White had never recovered from privations caused through being shipwrecked off the coast of Madagascar, about three years ago.

NEW COMPANIES REGISTERED.

Clements, Jeakes & Co., Ltd. (148,312).—Private company. Registered August 25th. Capital, £25,000 in 3,000 5 per cent. cum. pref. shares of £5 each and 10,000 ord. shares of £1 each. To take over the business carried on at 51, Great Russell Street, W.C., and at Macklin Street, Drury Lane, W.C., as Clements, Jeakes & Co., and to carry on the business of domestic, electrical, and general engineers, electricians, iron and brass founders, &c. The subscribers are: J. H. Clements, The Cottage, Roselyn Road, Watford, engineer; G. B. Clements, 26, Regent Square, W.C. 1, engineer. The first directors are: J. H. Clements and G. B. Clements. Registered office: 51, Great Russell Street, W.C.

Watercraft Detachable Power Installations, Ltd. (148,345).—Private company. Registered August 29th. Capital, £20,000 in £1 shares (12,500 pref.). Builders of and dealers in engines and power plant for the propulsion of watercraft of all kinds, electrical and general engineers, &c. The subscribers (each with one share) are: T. F. de Saulles, 25, Houghton Road, Birchfield, Birmingham, coal factor's manager; F. W. Heafield, 18, Frances Road, Handsworth, Birmingham, coal factor's cashier. The first directors are: E. W. Reid, T. H. Coggins, and A. E. Hooke. Solicitors: Shakespeare & Vernons, 83, Colmore Row, Birmingham.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Lancashire Electrical Engineering Co., Ltd.—Memorandum of satisfaction in full on July 27th, 1917, of charge dated March 30th, 1917, securing the sums owing on company's account with Union Bank of Manchester.

A. J. Wakelin, Ltd.—Memorandum of satisfaction in full on August 29th, 1917, of debentures dated May 22nd, 1914, and July 31st, 1916, securing £500, has been filed.

British Thomson-Houston Co., Ltd. (47,982).—Capital, £800,000 in £10 shares (40,000 ord. and 40,000 pref.). Return dated August 13th, 1917. All shares taken up. £725,310 paid; £74,690 considered as paid. Mortgages and charges: £173,495.

Burt, Escaré & Denelle, Ltd.—Capital, £40,000 in 25,000 ord. and 15,000 pref. shares of £1 each. Return dated May 8th, 1917. 19,332 ord. and 10,400 pref. shares taken up. £29,732 paid. Mortgages and charges: £7,500.

Bray, Markham & Reiss, Ltd. (74,871).—Capital, £20,000 in £1 shares. Return dated July 23rd, 1917. 9,650 shares taken up. £8,850 paid; £800 considered as paid. Mortgages and charges: Nil.

Anchor Cable Co., Ltd. (69,073).—Capital, £250,000 in £10 shares. Return dated June 14th, 1917. 6,500 shares taken up. £61,000 paid; £4,000 considered as paid. Mortgages and charges: £50,000.

United Electric Tramways of Monte Video, Ltd. (80,456).—Capital, £1,000,000 in 100,000 pref. and 100,000 ord. shares of £5 each. Return dated July 9th, 1917. All shares taken up. £295,105 paid on 26,221 pref. and 32,800 ord.; £704,895 considered as paid on 73,779 pref. and 67,200 ord. Mortgages and charges: £971,547.

United River Plate Telephone Co., Ltd. (23,654).—Capital, £2,000,000 in £5 shares (324,000 ord., 40,000 pref., and 36,000 unissued). Return dated June 26th. 324,000 ord. and 40,000 pref. shares taken up. £1,740,000 paid on 308,000 ord. and 40,000 pref.; £80,000 considered as paid on 16,000 ord. Mortgages and charges: £300,000.

Western Electric Co., Ltd.—Capital, £500,000 in £5 shares. Return dated May 29th, 1917. 68,805 shares taken up. £25 paid; £344,000 considered as paid. Mortgages and charges: Nil.

Walter's Electrical Manufacturing Co., Ltd. (94,300).—Capital, £13,000 in £1 shares. Return dated July 18th, 1917. 11,250 shares taken up. £1,250 paid; £10,000 considered as paid. Mortgages and charges: Nil.

Westinghouse Metal Filament Lamp Co., Ltd. (89,948).—Capital, £10,000 in £1 shares. Return dated May 10th (filed July 4th), 1917. All shares taken up. £7 paid; £9,993 considered as paid. Mortgages and charges: Nil.

CITY NOTES.

Tyneside Tramways and Tramroads Co.

At the half-yearly meeting, held at Newcastle-on-Tyne on August 28th, Mr. G. E. Henderson presided in the absence of Dr. J. T. Merz, the chairman, through ill-health. He said that the traffic receipts had increased by £5,538, compared with the corresponding period of last year, and, as might be expected, the costs also had increased. The amount available for allocation, after paying interest on mortgages, &c., showed an increase of £3,400. The directors proposed to pay a dividend at the rate of 4 per cent., compared with 1¾ per cent. for the corresponding half of 1916. They were also increasing the amount placed to reserve and special reserve by £1,061, and the carry forward they had increased by £774. The directors considered the present times abnormal, and any increased receipts which might be due to increased railway fares and reduced railway facilities should be also regarded as abnormal, and not as part of the ordinary progress of the company. They, therefore, thought it better to place a larger sum to the reserve fund. That latter account, with the additions made in the report, would now stand at £27,412, and their investments and loans at £26,134. The traffic receipts were continuing to increase, and for the seven weeks ending August 15th there was an increase of £1,532.

German Companies.

The Elektra A.G., of Dresden, reports for 1916-17 a loss of £6,000, as compared with a deficiency of £5,000 in the previous year. As in 1915-16, the loss for last year is to be met out of the special reserve fund.

The directors of the *Wolfram Lampen A.G., of Augsburg*, report net profits of £7,400 in 1916-17, as compared with £7,100 in the preceding year, and including the balance forward a total of £14,100 and £14,000 in the two years respectively. It is not proposed, however, to make any distribution, but to enter into voluntary liquidation on account of the destruction of the works by fire last May, the impossibility of erecting and equipping a new building, and the withdrawal of customers as a consequence of the recent judgment of the Imperial Court on the matter of the patents relating to wire-filament lamps.

The report of *Brown, Boveri & Co., of Mannheim*, characterises the year 1916-17 as a period of continued great activity and a maximum utilisation of the plant and machinery. The cost of labour and raw materials, however, increased so largely that it was impossible to take them fully into consideration on the acceptance of contracts. After setting aside £44,000 for depreciation, as against £46,000 in 1915-16, the accounts show net profits of £73,000, as contrasted with £58,000. It is proposed to pay a dividend of 12 per cent., this rate comparing with 10 per cent., 5 per cent., and 5 per cent. in the three preceding years respectively.

The Continentale Ges. fur Elektrische Unternehmungen, of Nuremberg, which is a financial organisation of the Schuckert group, reports that the many years of the company's activity in the construction and working of electricity supply works and tramways in Italy was brought to a standstill in the year ended with March 31st, 1917. It was possible to realise these investments on suitable terms, and the money thereby realised was applied partly to the repayment of credits granted by the Schuckert Co. and partly to the purchase of German loans. The entrance of Roumania into the war had cut off connections with the Jassy electricity works, and no information was available as to the situation of that undertaking. The traffic on the secondary railways and tramways in which the company is interested was more active than in the preceding year, but the working expenses experienced a large increase, and the financial results were again unfavourable. Including the balance brought forward, the net profits in 1916-17 are returned at £44,000, as in the previous year, and the dividend is at the rate of 2½ per cent. on capital of £1,556,000, being the same as in 1915-16.

The Deutsch Sudamerikanische Telegraphen Gesellschaft, of Cologne, states that since the issue of the report for 1915 no alterations in the condition of the company's cables, so far as could be seen from the results of tests available to the company, had taken place, and working was at a standstill. It could not be foreseen what the consequences would be of the rupture of diplomatic relations between Brazil and Liberia in regard to the stations at Pernambuco and Monrovia and the other property there. The receipts in 1916 amounted to £205,000, as compared with £182,000 in the preceding year, and the net profits are returned at £54,000, as against £41,000. A dividend has been declared at the rate of 5 per cent. as compared with 6 per cent. in 1915, on ordinary share capital of £625,000. The report also mentions that the accounts for 1916 of the Compania Telegrafico-Telefonica del Plata had not reached the company, but as the financial position of this Argentine company led to the assumption that it would not be able to pay any dividend for last year, the Cologne company had set aside £19,000 as reserve for its investment in that company.

Russian Companies.

The Petrograd Electric Lighting Co. of 1886 records net profits of £809,000 for 1916, as contrasted with £680,000 in the previous year. Apart from the dividend of 10 per cent. on the preference capital, the ordinary shares are to receive 7 per cent., but the distribution of the profits, as a year ago, is deferred to a future occasion.

The Russian A.E.G. is reported to have earned gross profits amounting to £625,000 in 1916, and net profits of £280,000, as compared with £223,000 in the previous year. It is proposed to pay a dividend of 10 per cent. on ordinary share capital of £1,200,000, as in 1915, the new shares for £1,200,000 not participating in the distribution for 1916. The undertaking is being continued as a Russian concern by a new company under the title of the General Electricity Co., with a capital of £2,400,000.

The Russian Siemens & Halske Co. reports gross profits of £336,000 for 1916, of which £125,000 has been devoted to depreciation, £16,000 placed to the reserve fund, and £91,000 applied to the payment of taxes on war profits. The balance permits of the payment of a dividend of 12½ per cent. on the old shares and 7½ per cent. on the new shares, the total share capital being £700,000. The company's undertaking and that of the Russian Siemens-Schuckert Works are now being taken over by a Russian company with a share capital of £2,500,000.

City of London Electric Lighting Co., Ltd.—Dividends announced on account of the distribution for the year ending December 31st, 1917:—On the preference shares 6s. per share, on the ordinary shares 6s. per share, both subject to the deduction of income-tax.

Brazilian Traction, Light & Power Co., Ltd.—Quarterly dividend of 1¼ per cent. on the fully-paid cumulative preference shares.

Clyde Valley Electrical Power, Ltd.—Interim dividend, 1¼ per cent. actual on the ordinary shares, free of tax.

Newcastle-upon-Tyne Electric Supply Co.—An interim dividend of 2½ per cent. on the ordinary shares, less tax, is announced.

London Electric Supply Corporation, Ltd.—The directors, for reasons entirely attributable to the war, have deemed it advisable not to distribute a dividend on the preference shares, but to carry forward the profit earned in the half-year ended June 30th last.—*Financial Times.*

Davis & Timmins, Ltd.—Interim dividend, 6 per cent. per annum, free of income-tax, on ordinary shares for the half-year.

Madras Electric Tramways, Ltd.—Interim dividend on ordinary shares for the half-year ended June 30th, 8 per cent. per annum.

Canadian General Electric Co., Ltd.—Quarterly dividend of 2 per cent. for the three months to September 30th on the common stock, and a half-yearly dividend of 3½ per cent. for six months (at the rate of 7 per cent. per annum) on the preference stock.

Reduction of Capital.—*Pollock & Macnab.*—A petition for confirming a resolution reducing the capital from £60,000 to £50,000 has been presented to the Court.

Marconi International Marine Communication Co., Ltd.—The directors have been offering to the shareholders 250,000 new shares of £1 each at the price of £1 15s. per share.

STOCKS AND SHARES.

TUESDAY EVENING.

THERE is little diminution of the strength of markets as a whole, and the news from Riga failed to depress materially any Stock Exchange prices, with the exception of those immediately concerned. A considerable amount of buying has taken place amongst the industrial groups; and, as an instance of the way in which prices respond to any little attention which may be drawn to them, the case of Edison Swan shares is appropriate. The consideration advanced that, having regard to the splitting of the shares which will take place before the end of the year, last week's quotation of 19s. was tempting to the buyer, evidently attracted a good deal of notice, because the price ran up to 23s. in a couple of days, reacting as the profit-takers came in to 21s. 6d. Other members of the manufacturing group are also being inquired for, and the £5 shares in the Edison Company have themselves risen from 30s. a fortnight ago to 35s. now. As a speculation, they are probably worth buying to-day, though the qualification requires emphasis.

Substantial recoveries have occurred amongst the stocks in the Underground Railway group. Revision of the fares came into force on the tube and 'bus systems last Saturday, and this is held to constitute a strong bull point in favour of Metropolitans, Districts, and, of course, the issues of the Underground Electric Railways Company itself. The Income Bonds of the last-named have risen to 84¼, *ex* the £2 net dividend deducted on Monday. The £10 shares are better at 35s., and the shilling shares have come in for a little notice on a slightly improved basis. Metropolitans have risen 1½ to 24¼, Districts the same amount to 16½. They have the market to themselves, these Undergrounds, because the rest of the Home Railway market is dull, heavy, and listless, thanks to the incessant demands made by this or the other section of railway men.

Further progress has been made in the upward direction by electric lighting shares. Interim dividends are now being declared, and two or three prices have advanced quotably, though the rest are left unchanged. Buyers, however, find that their orders are extremely difficult to fill, and that their stockbrokers report shortage of shares in nearly all the group. It is being assumed that the electric lighting companies have now got down to a level of dividend which is likely to prove bedrock, so far as the war-time is concerned; while, afterwards, there is more than a fair prospect of the pre-war standard being attained.

There is a feeling—it can scarcely be described as a rumour—in the air that closer unity will yet be established between the various electric supply undertakers, and that any move in this direction is bound to have the effect of benefiting the companies through the saving of expenditure which would inevitably follow. This idea does not confine itself entirely to London companies. Those in the provinces are also expected to be affected. As we have just remarked, however, it is no more than an impression at present, although it adds to the strength of the market as a whole.

The cable market is good, with improvements in Eastern Telegraph ordinary stock and two or three of the others. A very fair volume of business is being transacted here, but, as before, shares are in short supply. Something of a feature is the firmness of International Marconi Marine shares, which have risen sharply on the company's announcement of a new issue of shares at a price which will give existing holders a profit of about 17s. 6d. per new share.

Proprietors are invited to apply at 35s. for as many shares as they like; and as it is uncertain what proportion they will be allotted, the Stock Exchange has been unable to fix any definite price as the value of the rights, although Marines are quoted this week *ex* rights. After touching 2½, the price reacted to 2 1/16. The shares in the parent company are practically unchanged at 3 3/16, most of the interest centring upon Marines for the time being. Canadians and Americans remain at 9s. 6d. and 16s. 3d. respectively.

Mexicans move in somewhat bewildering fashion. After a bout of most unusual strength, the markets concerned in Mexico have halted; and in several cases holders of the stocks and bonds have taken advantage of the big rise in prices in order to realise their securities. Mexico Trams got up to 40, but reacted to 35, and Mexican Light and Power Common from 30 came back to 24. Yet the Preferred shares in the latter company have moved up another 3 points, and the bonds are steady. Brazilian Tractions further eased off to 47, another drop of a point, though the Preferred improved to 93.

The Anglo-Argentine Tramway group is very firm. Proposals are now before the Argentine Government with a view to enabling the railway companies to raise their fares; and it is more than half expected that, if these are allowed, the Tramway Company will also follow suit. Rio Tramway and San Paulo Tramway Bonds are both better.

Amongst miscellaneous shares, British Aluminium Ordinary and Edison Swan's have divided most of the attention. The former jumped to 33s. 3d., while Edisons, as mentioned before, rose from 19s. to 23s. before reacting to 21s. 6d. The £5 fully-paid shares at 35s. are 5s. higher, following upon their rise of 2s. 6d. last week. No change has occurred in the Debenture stocks. British Insulated at 14 have another 10s. to their credit. India-Rubbers and Telegraph Constructions are both strong. Babcock & Wilcox have been wanted in the North of England up to 63s. 6d., and the price in London reflects this demand.

There is no particular change in Callenders. Henleys have recovered the dividend of 5s. It is thought that British Westinghouse Preference at 2¾ possess more than a sporting chance of improvement. They are 15 per cent. shares, and received dividends in the last two years of 7½ per cent. per annum, so that the yield at the present price is about 5½ per cent. on the money. It may be only the optimism permeating the industrial market as a whole which points the anticipation of a rise in Westinghouse Preference, but the shares will be interesting to watch, at all events, for the next few weeks.

The Rubber Market is good, thanks to a rise in the raw stuff to 2s. 9½d. per lb. An explosive rise in most of the powder companies' shares is another of the features in the Industrial Market; and just lately some of the Mining sections have begun to wake up, the improvements including a good many of the shares in the companies of the base metal group.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1915.	Dividend 1916.	Price Sept. 4, 1917.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	9	6½	—	£7 4 0
Charing Cross Ordinary	5	5	3½	—	6 9 0
do. do. do. 4½ Pref.	4½	4½	3½	—	6 18 4
Chelsea	4	3	3½	—	5 4 4
City of London	6	6	13½	+ ½	6 0 9
do. do. 6 per cent. Pref.	6	6	10	—	6 0 0
County of London	7	7	11½	—	6 3 1
do. 6 per cent. Pref.	6	6	10½	—	5 17 1
Kensington Ordinary	7	6	5½	—	5 14 8
London Electric	3	3	1	—	Nil
do. do. 6 per cent. Pref.	6	4	3½	—	5 6 8
Metropolitan	3	3	3	—	5 0 0
do. 4½ per cent. Pref.	4½	4½	3½	—	7 4 0
St. James' and Pall Mall	8	8	7	—	5 14 6
South London	5	5	2½	—	7 5 6
South Metropolitan Pref.	7	7	21/6	—	6 10 3
Westminster Ordinary	7	7	6½	+ ½	5 7 8
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	28	—	5 2 5
do. Def.	33/8	1½	22½	—	6 16 4
Chile Telephone	8	8	7 1/16	—	5 11 4
Cuba Sub. Ord.	5	5	3½	+ ½	5 14 3
Eastern Extension	8	8	14½	—	*5 9 4
Eastern Tel. Ord.	8	8	147/8	+1½	*5 8 4
Globe Tel. and T. Ord.	7	7	12	—	*5 9 10
do. Pref.	6	6	10½	—	5 15 8
Great Northern Tel.	23	24	36	—	6 13 4
Indo-European	13	10	54½	—	5 19 3
Marconi	10	15	3 1/16	—	4 15 10
Oriental Telephone Ord.	10	10	8½	+ ½	3 1 6
United R. Plate Tel.	8	8	6 1/16	—	*5 15 4
West India and Pan.	6d.	6d.	1½	—	1 13 0
Western Telegraph	6	6	14½	—	*5 10 4
HOME RAILS.					
Central London, Ord. Assented	4	4	6½	+1	6 10 1
Metropolitan	1	1	24½	+1½	4 3 6
do. District	Nil	Nil	16½	+1½	Nil
Underground Electric Ordinary	Nil	Nil	1½	+ ½	Nil
do. do. "A"	Nil	Nil	5/8	—	Nil
do. do. Income	6	4	84¼xd	+3½	*4 14 8
FOREIGN TRAMS, &c.					
	Dividend 1915.	Dividend 1916.			
Adelaide Sup. 6 per cent. Pref.	6	6	4½xd	—	6 3 1
Anglo-Arg. Trams, First Pref.	5½	5½	3	+ 1/16	9 5 4
do. 2nd Pref.	5½	—	2½	—	—
do. 5 Deb.	5	5	67	—	7 9 8
Brazil Tractions	4	4	47	—1	—
Bombay Electric Pref.	6	6	9½	—	6 4 8
British Columbia Elec. Ry. Pfds.	5	5	45½	—2	10 19 10
do. do. Preferred	Nil	Nil	21	—	Nil
do. do. Deferred	Nil	Nil	20	—	Nil
do. do. Deb.	4½	4½	58	—	7 14 7
Mexico Trams 5 per cent. Bonds	Nil	Nil	30½	+1	Nil
do. 6 per cent. Bonds	Nil	Nil	37½	+4	Nil
Mexican Light Common	Nil	Nil	25	—6	Nil
do. Pref.	Nil	Nil	35½	+8	Nil
do. 1st Bonds	Nil	Nil	50	—	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	16	16	34	—	4 15 10
British Aluminium Ord.	7	10	1 3/16	—	6 1 3
British Insulated Ord.	17½	20	14	+ ½	7 9 10
British Westinghouse Pref.	7½	7½	27	—	5 9 1
Callenders	20	20	14½	—	7 0 6
do. 5 Pref.	5	5	9½	—	6 1 8
Castner-Kellner	22	22	3 1/16	—	6 8 0
Edison Swan, fully paid	—	—	1½	+ ½	Nil
do. do. 4 per cent. Deb.	4	4	7½	—	5 12 0
Electric Construction	7½	7½	13	—	5 0 0
Gen. Elec. Prof.	5	5	10½	—	5 17 1
do. Ord.	10	10	16	—	6 5 0
Henley	25	25	18xd	+ 1/16	7 16 8
do. 4½ Pref.	4½	4½	4	—	5 12 6
India-Rubber	10	10	15½	—	*7 6 10
Telegraph Con.	20	20	26½	—	*5 5 9

* Dividends paid free of income-tax.

V.B. CABLE BREAKDOWNS IN THE TROPICS.

By C. J. BEAVER, M.I.E.E.

The article on this subject in the Electrical Review of August 24th, 1917, by Mr. D. M. W. Hutchison, Chief Electrical Inspector of Mines in the F.M.S., does not constitute so serious an indictment on V.B. cables under tropical conditions as might at first sight appear. From the opening paragraph it might be inferred that the cause of failure under tropical conditions had not been investigated by the cable makers, and that the latter are content to account for it by assuming that the conductors have been overloaded, and that the resultant overheating has allowed decentralisation to occur.

This entirely ignores a recent detailed account of an investigation of the subject in the Tropics given in an I.E.E. paper on "Cables" by the present writer (see Electrical Review, December 4th and 11th, 1914, pages 770 and 802, and *Journal* I.E.E., Vol. LIII, 1914, page 74 *et seq.*). It will be presumed in the following notes that readers sufficiently interested will be more or less cognisant of these references, in which it was conclusively shown that such trouble as has occurred in V.B. insulated cables in the Tropics has not been due—as might appear from Mr. Hutchison's references to overload, sun temperature, &c.—solely to tropical temperature conditions. Heat was found by the present writer to be only one of the factors in the case, and one which would not alone produce the trouble. In the investigation above referred to, the factors determined by very comprehensive survey and diagnosis of the results of minute examination of cables and their surroundings, confirmed by further investigation on the spot (comprising both positive and negative evidence), and subsequently corroborated by experimental reproduction of the effects, were heat, moisture, leakage current and time.

The first stage leading to failure is usually a physical change whereby the V.B. is softened. It was previously known to the writer that such softening might be of a character distinct from that which occurs quite locally in the vicinity of a fault on a negative V.B. cable, commonly known to be due to a saponification effect on the V.B. following on the local production of alkaline substances by the electrolytic action of the fault current. Its occurrence was also known to be distinct, not being confined to negative cables, but arising on positive, negative, and neutral cables indiscriminately. It also occurred on cables carrying alternating current.

Softening due to heat and moisture under exaggerated temperature conditions was known by the manufacturer to occur in the process of vulcanisation of the bitumen, but being accountable for by local retardation of vulcanisation due to the presence of moisture, its real significance was not appreciated until these factors were determined by the investigation referred to. This type of softening (in the absence of alkaline material) was shown to be considerably facilitated by the action of current from a source external to the part acted upon, moisture being an essential factor in forming paths for such current.

When the V.B. becomes sufficiently softened to become displaced and to allow leakage from the affected part, the effect of current tends to predominate, and softening proceeds rapidly, although the defect may not, and usually does not, for reasons which will be considered later, constitute a fault which will definitely declare itself.

Another feature, to which due significance had not previously been attached, was that the softening and consequent breakdown effects were local and not general.

The writer had, prior to his investigation in the Tropics, frequently asked for information on this point, and invariably received the answer that it was general.

The misleading character of this reply is doubtless due to the fact that little is seen of the cables in the ordinary course by those in charge of them, except at parts where trouble occurs; and in such cases the urgency of affairs connected with supply is such that other questions are considerably subordinated thereto. Even if a sample and a fairly lucid description is sent home, it is not only difficult to correctly diagnose the original cause of breakdown, owing to the impossibility of distinguishing symptoms of effect from those relating to cause, but the question of the condition of surroundings and adjacent parts has practically no light shed upon it. Not only the microscope, but the field glass is necessary when fundamental questions are involved.

Mr. Hutchison says, when describing the character of certain faults in a V.B. distribution network, "the bitumen sheathing for several feet on each side of the fault was soft and sticky," but he does not mention the important point as to whether this state continued or ceased. It is clear that if it did cease, as in the writer's experience it frequently would, Mr. Hutchison's opinion that "V.B. cables are quite unsuitable for tropical countries" only applies to part of the cable. This variation leads to the obvious suggestion that extraneous and not inherent causes are responsible for the effects.

The writer has frequently seen normal and considerably deteriorated cables side by side in the same bitumen-filled trough, as well as transitions from one stage to another within a few inches in the same cable.

Some remarkable cases of the latter are described in the paper above referred to, where in the case of armoured service cables laid direct in the ground, a sharp line of demarcation existed between parts above and parts under the ground, the former being quite normal and the latter appreciably affected. Again, in feeder pillar cables, variations in the physical state of the V.B. coincided with local leakage circuits, due to damage of the insulation where the cables entered the pillars, and defective trims at terminal lugs. These coincidental variations were not accidental occurrences, the number of instances checked for confirmation, and the consistent character of the results of examination putting this beyond doubt.

As temperatures above ground were in these cases considerably in excess of the temperatures below ground, and as cables which had been stored for years showed no evidence of deterioration, it was quite clear that tropical conditions, *per se*, were not the cause of trouble.

To summarise the matter, the conclusions above referred to were drawn from such a mass of evidence as to render them practically incontrovertible.

Apart from the experimental reproduction of the effects which was subsequently successfully carried out, a number of opportunities have been taken of checking the conclusions in various cases which have since been submitted for the writer's examination.

Such additional evidence as has been gained has been almost invariably confirmatory in character. For instance, with regard to the factor of current, confirmation of its passage through apparently solid masses of trough filling bitumen has been afforded by examination of globules of water enclosed in such masses. They have been found in some cases strongly alkaline and in others distinctly acid, according to the polarity of the cable to which they were in close proximity, though not in contact. It may be added that in these cases the cause of the leakage was damage due to subsidence of ground.

In most cases the value of the leakage current concerned is probably of a minute order, and, from this point of view, non-metallic sheathed cables are certainly at a disadvantage, because, in the first place, insulation resistance tests give very indefinite results, which do not indicate the intrinsic soundness of the dielectric proper (this being usually in series with other insulating materials, such as trough-filling bitumen, &c.), and, secondly, for the same reason, faults do not readily breakdown on account of the high resistance of their path to earth. This maintenance difficulty is, in the writer's opinion, the key of the whole trouble so far as distribution networks of V.B. cables are concerned. The effects of the factor of current are cumulative—local leakage circuits producing softening and, in turn, other leakage circuits, which go on reacting with each other—so that a considerable amount of deterioration occurs before any electrical indication of it is available. It must be remembered, although it is frequently overlooked, that in such systems it is only the balance of fault current which returns *viâ* earth to the station, and therefore ideas as to the total amount of leakage in a network may be very

erroneous. It will therefore be seen that, so far as distribution networks are concerned, the whole matter turns on efficient installation and rigid and minutely-organised maintenance.

With regard to the three-core solid V.B. double-wire armoured cables supplying the pumps in a tin mine in the F.M.S. referred to by Mr. Hutchison, the writer has seen samples which probably came from this installation.

The general description of the installation bears a remarkable similarity, although the description of the mechanism of failure does not correspond to the description which Mr. Hutchison gives of "the cores coming together and short-circuiting." This, however, may have been assumption on his part.

In the shaft and adit samples examined by the writer neither of the faults were between phases. In the former, the cores had locally—at a bend where the cable turned from the vertical to the horizontal at the shaft bottom—approached the armour at the inner radius of the bend. The original thickness of dielectric between the cores was, however, fully maintained throughout the faulty part, and, moreover, they returned *en masse* to their central position within 2 ft. to 3 ft. of the fault. The atmospheric conditions were said to be steamy, or foggy with moisture, at a temperature of 110° F. These conditions presumably allowed, or produced, sufficient weakening of the exterior part of the V.B. to allow the internal mechanical stress due to the bend to overcome its resistance, but it is significant that the inner part between cores, which was presumably hotter because of the current carried by the conductors, did not yield. There was some softening of the outer part of the V.B.—probably commenced by the two factors of heat and moisture, and subsequently accentuated by leakage current—but the inner parts were quite normal. Generally, therefore, there was nothing mysterious about the failure, nor anything at variance with previous knowledge.

In the case of the adit cable, the fault appeared to be primarily due to a mechanical trouble. So far from the cores coming together, they had uniformly splayed out until they locally approached the armour. This being quite opposed to the normal tendency, it seemed clear that a mechanical stress had been set up during installation which tended to untwist the cores, and the writer's conclusion was that a certain amount of bending or kinking had occurred when the cable was being carried into the adit by the Chinese coolies, and that the mechanical stress referred to was the result of efforts to straighten the cable.

It may be added that instances similar to this are not unknown at home when cables are carried in-bye in coal mines on the shoulders of labourers.

With regard to a remedy for the non-mechanical causes of breakdown, the investigation described in the paper above referred to, the subsequent reproduction of the effects, and the study of the chemical and physical aspects of the subject led to the conclusion that the primary stage—the softening process—might be averted by the physico-chemical expedient of incorporating with the V.B. some colloidal substance, incapable of decomposition by hydrolytic action, and exerting a maximum protective effect when present in small proportion.

Experiments in this direction ultimately showed that high-grade vulcanised rubber could be so treated that it would fulfil these requirements,* and that a very small proportion of the admixture afforded a surprising degree of protection. In fact, the combination had properties not possessed by its components.

It has been shown above that what appears to the casual observer to be a combination of mechanical weakness (permitting decentralisation) and chemical change (softening) is primary and not ultimate in character, and having provided against this primary or fundamental source of the trouble, the mechanical aspect of the matter may fairly safely be left to take care of itself under normal conditions of laying or fixing.

It may be, as Mr. Hutchison suggests, that paper lead-covered cables would give good results in the hands of trained Oriental jointers, but consulting engineers at home do not yet appear to be convinced that the instruction imparted by European jointers in the East has sufficiently leavened the lump.

The relative carrying capacities of paper lead-covered and V.B. insulated cables are not so widely different as is often supposed; in fact, under some conditions of installation there is no difference in this respect. The non-hygroscopic character of V.B. which prevents a local damage causing the ruin of a long length of cable, will always constitute a strong argument in its favour as compared with hygroscopic insulating material—such as paper and varnished cambric. The fact that these latter materials are dependent for the preservation of their insulating properties on the provision of a lead covering and on its maintenance intact, is a particular disadvantage in mining installations, where the fixing conditions are invariably awkward and the risks of damage considerable.

It is on account of these considerations that the solid type of wire-armoured V.B. cable has had such a vogue in mining work at home.

* Patent No. 9,554/1914.

THE MANUFACTURE OF NITRATE OF AMMONIA BY ELECTRIC POWER AT COKE OVEN PLANTS.

By E. KILBURN SCOTT, A.M.I.C.E., M.I.E.E.

(*Abstract of paper read before the* Coke Oven Managers' Association.)

Whenever reference is made in papers or articles to by-products of coal, the utilisation of the ammonia is always assumed to be as sulphate of ammonia.

In order to make this, compound sulphuric acid has to be purchased at prices which are fixed by the acid associations, and, further, it has often to be carried to considerable distances, which adds to the expense. In peace time there is usually plenty of acid, but since the war it has been very scarce.

This paper proposes to show that manufacturers of coke can easily turn their ammonia by-product into nitrate by means of acid of their own manufacture; also that by making their own acid they become entirely independent of the acid associations, which have for so long controlled the supplies in this country.

The nitric acid required for nitrate of ammonia may be very dilute—of, say, 25 per cent. to 33 per cent. strength—and it is easily and cheaply made from the air by electric power.

When ammonia is obtained as a by-product of the distillation of coal, the cost may be, as in the case of most by-products, only a little above the interest charge on the recovery plant plus the cost of operating the same.

A battery of 50 regenerative ovens of, say, medium size Coppée type, will coke 360 tons of coal per day. Taking coal of average quality, containing 10,000 cu. ft. of gas per ton, and assuming 50 per cent. as being surplus gas, there would be 1,800,000 cu. ft. of surplus gas per day. Large gas engines working on such gas have been found to use about 21 cu. ft. per brake-horse-power per hour, so this quantity of surplus gas should develop about 3,500 h.p., which, with modern electric generators, is equivalent to about 2,500 kw.

Power may also be obtained from waste-heat ovens by using the steam in high-pressure steam turbines.

A battery of 50 waste-heat ovens of, say, medium size Coppée type, will furnish enough waste heat to raise about 350 tons of steam per day in high-pressure boilers. If the steam is superheated, and used in modern steam turbines, a consumption of about 11 lb. of steam per horse-power per hour is attainable, and the power should therefore be about 3,000 h.p., which, with modern electric generators, is equivalent to about 2,000 kw.

I understand that beehive ovens are kept in use, partly because the coke is supposed to be more suitable for making crucible steel than any other kind. This appears to be a fallacy, but in any case electric steel furnaces which do not require any coke are rapidly coming into use.

I propose to give figures for a power plant capable of generating 1,000 kw. continuously, and an electrochemical factory to utilise that amount of energy. Readers must remember, however, that the larger the plant the lower the first cost per kw. installed.

The following is the approximate cost of power-house plant for utilising coke-oven gas in direct coupled gas engines:—

Three 500-kw. vertical type gas engines direct coupled to three-phase alternators, complete with two motor-driven circulating water pumps for the engine jackets, compressed air starting equipment, also piping and valves. Gas mains from ovens to purifiers and thence to gas engines, also the purifiers to rid gas of sulphur before passing it to the gas

engines, £28,000. Under normal conditions this should be sufficient to cover buildings, foundations, and all incidental expenditure.

The following is the approximate cost of power-house plant for utilising waste heat to raise steam for turbines:—

Three 500-KW. steam turbo-alternators of Westinghouse or other good type, each complete with condenser, motor-driven extraction pump, valves and fittings, £20,000; also steam-raising equipment for above, consisting of boilers and superheaters, economiser, steel chimney, feed pump, steam and water piping, and gas mains from ovens to boilers, £9,000; total, £29,000.

It will be seen that for the size of power-house, the price is about the same for each kind of plant. For larger sizes the cost of a steam plant is lower than a gas-engine plant, also the limiting size of a gas-engine unit is about 1,000 KW. Steam turbine units can be built for practically any output, and the larger they are the better they work, and the lower the steam consumption.

Gas engines give high thermal efficiency, but unless precautions are taken they do not work well with coke-oven gas, because of the snappy action due to high percentage hydrogen.

Leaving a fair margin of profit, electrical energy ought to be supplied from such a power-house at ¼d. per unit. At this figure, 1,000 KW. for 8,000 hours a year would bring a return of £4,166.

From this must be deducted the standing charges, labour, and stores, and also any figure that the coke-oven proprietor feels justified in charging for the gas or waste heat. As he is selling to himself, it is merely a matter of book-keeping, and profit can be shown in steps or on the finished product only.

The plant required to fix atmospheric nitrogen as nitric acid partly consists of electrical apparatus and partly of chemical, the latter being by far the largest and most expensive part, and taking up most space.

The plant consists of:—Electric furnaces and boilers; switchgear and instruments; fans for air supply and circulation of gases; apparatus for cooling and oxidation of the gases; &c. Also the acid and alkali absorption towers or chambers, complete with acid elevators or *montejus* and distributors, &c.; reservoirs and mixing tanks; crystallising and drying plant, &c.

The furnace is that which I have specially developed for the purpose. It differs from those in use abroad in that it is a self-contained three-phase unit, and as such it has various advantages.

The recognised method of measuring the yield of the furnace is to find the output of dilute nitric acid which it gives in a given time for a given amount of electric energy. The acid is resolved into the equivalent amount of pure nitric acid of 100 per cent. strength.

Usual yields for single-phase furnaces are about 50 grammes per KW.-hour with 60 as a maximum. Careful tests carried out over a considerable period with my three-phase furnace have shown considerably higher yields.

To make nitrogen peroxide gas into acid, it has to be brought into contact with water, and a convenient way of doing this is to have several absorption towers filled with acid-proof tiles arranged so that the liquor and the gases pass in contraflow direction. The acid is drawn off at 25 to 33 per cent. strength, which is strong enough for making ammonium and calcium nitrates.

At the end of the acid-absorption towers there is a further tower also filled with tiles, down which caustic soda trickles. This has a stronger affinity for the gas than has water, and the small amount which passes over from the acid towers is thus quickly absorbed, and forms a mixture of sodium nitrate-nitrite, which is used in the aniline dye manufacture.

Another form of absorption tower than can be employed gives acid up to 50 per cent. strength.

The manufacture of nitrate of ammonia is carried out by running the dilute nitric acid from the absorption plant into a closed iron tank containing ammonia solution, in which the ammonia is at about 25 per cent. strength. Acid is slowly added to a large volume of liquor, and an agitator mixes them together, the heat of combination being carried off by cooling coils as well as by circulation of air.

The addition of acid continues until nearly all the ammonia is taken up, leaving a slightly alkaline reaction.

The ammonium nitrate solution is then run through a filter into vacuum pans, where evaporation is effected by steam coils at a pressure of 20 mm. of mercury.

When nearly all the water has been evaporated the solution passes into long troughs slightly inclined, and subjected to a rocking motion. The nitrate forms into small crystals with no enclosure of liquor, and after the crystals have been dried in a hydro-extractor they are placed in bags or barrels ready for market. The nitrate is absolutely pure.

We will assume that the electrochemical plant is of such size as to utilise 1,000 KW., the round figure above mentioned, which the power house will supply continuously.

For the electrochemical plant £8 per KW. is a fair price, so the total is £8,000.

The price of electrical energy is assumed at ¼d. per unit, which is fair, because electrochemical factories in this country have been supplied with electrical energy at under that figure for many years.

The number of working hours in a year—namely, 8,000—is convenient because it leaves a balance of 760 hours for overhaul time, &c., and thus less spare plant is required. It also allows for intermittent running off the peak in winter, if found necessary.

Depreciation on the electro-chemical plant may be taken at 10 per cent., this being sufficient to pay for a new plant in about seven years. A large proportion of the capital cost is required for absorption plant, which is of robust construction, like a chimney, the depreciation for which is usually taken at 2½ per cent.

The yield of acid is reckoned at 1¼ tons of 33 per cent. nitric acid per KW.-year—that is to say, 1,500 tons from a plant utilising 1,000 KW. This is based on a yield of 66 grammes of concentrated acid, or 200 grammes of 33 per cent. acid per KW.-hour. As a matter of fact, greater yields are obtainable, but the above figure is sufficient for the purpose.

Assuming the electrochemical plant to cost £8,000, and to utilise 1,000 KW. for 8,000 hours per annum at ¼d. per unit, the expenses are:—

Electrical energy	£4,166
Depreciation, 10 per cent. on £8,000	800
Salaries, wages, stores, royalty, &c.	1,790
	£6,756

This, for an output of 1,500 tons, gives £4½ per ton of 33 per cent. nitric acid, or the equivalent rate for pure acid is £13 10s.

For a plant to utilise 10 times the amount of energy, or 10,000 KW., the cost should be well under £4, even taking the above figures for the yield.

The amount of ammonium nitrate that can be made by such a plant is 135 tons of pure ammonia plus 1,500 tons of 33 per cent. nitric acid, giving 635 tons of pure ammonium nitrate.

As to the value of ammonia from the coke-oven gas, I intend to take the figure of £30 a ton, or 3¼d. a lb. The cost per ton may now be set out at follows:—

1,500 tons of 33 per cent. nitric acid at £4½ ...	£6,750
125 tons of pure ammonia at £30	3,750
	£10,500

As this produces 635 tons of ammonium nitrate, the cost is £16½ per ton.

In addition to ammonium nitrate, there is also the sodium nitrate-nitrite. This may be assumed at one-tenth of a ton per KW.-year, and it is readily saleable. It should be worth £1,500 a year.

There is a margin between the above calculated cost and the normal selling price of 100 per cent. I leave it to readers to whittle this down as they think fit to allow for inefficiency of reaction and other contingencies. When that is done there will still be a large margin.

Before the war, nitrate of ammonia made by the electrical process in Norway was sold in large quantities at £28 to £30 a ton. Properly speaking, there is no quotation now, because all the make is taken by the Government for explosives. Its minimum price may, however, be fairly taken at double the above figure.

What will happen after the war we cannot tell, but one thing is certain—namely, that the price per unit of contained nitrogen will be higher for nitrate of ammonia than any other nitrogen compound. This has always been so, because the combined nitrogen is 35 per cent.

Usual percentages of combined nitrogen are given in the following table:—

Name.	How obtained.	Usual per cent. of nitrogen.
Sodium nitrate	From Chile	15½
Sulphate of ammonia ...	By-product of coal	18
Calcium nitrate	Made by electric power	18
Calcium cyanamide	Made by electric power	13
Nitrate of ammonia	Made by electric power	35

As a means of transporting combined nitrogen from one part of the world to another, nitrate of ammonia is better than any other medium, so it is likely always to hold the field in the export market.

Nitrate of ammonia is the principal ingredient of most safety mining explosives, the word "safety" being a relative term expressing the fact that they are safer than dynamite, &c.

The British and certain other Governments have passed regulations insisting on only safety or permitted explosives being used in mines. The more this idea extends the more nitrate of ammonia will be required.

The present demand for nitrate of ammonia for making up burster charges for shells is tremendous, and it is no exaggeration to say that we are now using more in a week than before the war we used in two years.

Under the trade name of "ammonal" (a mining explosive used before the war), nitrate of ammonia mixed with powdered aluminium and certain other ingredients is used as the burster charge for hand and rifle grenades.

Explosives are likely to be used to a much greater extent after the war than was the case before, because soldiers who have been accustomed to handling them will have no hesitation in using explosives for agriculture when they go back to the land.

For breaking up soil and making holes for fruit trees explosives are already much used, because the soil is thoroughly loosened, and this enables the roots to grow easily, and moisture to get to them. For breaking up the underlying "hard-pan" of soils of hot countries, explosives are also very useful.

As the safest form of explosives nitrate of ammonia should be much used for this work; indeed, it is likely that Government regulations similar to those for mines may be drafted for agriculture.

I believe that after the war nitrate of ammonia will come into use as a fertiliser. The expert gardeners of France and Belgium have used it for intensive cultivation for some years. Nitrate of ammonia is an all-round fertiliser. Also, it has the advantage that when it gives up its nitrogen to plants only the constituents of water are left behind.

The principal objection to nitrate of ammonia is that it is deliquescent, but this is likely to be overcome, and careful experiments to this end are now being conducted.

Before the war practically all the nitrate of ammonia used in this country for making safety explosives for mining, &c., was imported from Norway, which, considering the necessity for nitrate of ammonia, is another instance of the absurdity of allowing foreigners to control businesses important to the nation.

Before the war Germany was the largest purchaser of Chile nitrate, taking twice as much as the next consumer, the United States, and over six times as much as this country. Now Germany does not require any Chilean product, because immense plants to make nitrates from the air have been established.

It will easily be seen that by making nitrates from air the Germans are at a great economic advantage, for our complete dependence on Chile nitrate means we have to pay large sums for the nitrate and for transport, insurance, &c. Also, there is part of the immense national charge for protecting the sea routes by which we get it here. Large sums are also required for the pyrites, sulphur, and for the plants to manufacture sulphuric acid with which to treat the nitrate.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

SWITZERLAND.—A Federal Decree, dated June 30th, consolidates and extends the prohibitions of export formerly in force. The effect of the measure is to prohibit the exportation as from July 7th of *goods of all kinds with the exception of those specified;* export licences may, however, be granted by the Department of Public Economy in so far as national interests permit. Among the goods excepted are china insulators, dynamo-electric machines, and electrical transformers, induction coils, high-tension coils for dynamos, and electric arc lamps.

Another Decree contains provisions respecting the particulars which are required to be entered in import and export declarations, the collection of the statistical tax—*vide* the ELECTRICAL REVIEW of May 18th—and the exemption from this tax accorded to certain classes of traffic, &c., &c. The text of the Decree may be consulted at the Department of Commercial Intelligence, 73, Basinghall Street, E.C. 2.

TUNIS.—By a Beylical Decree, dated May 16th, lead and lead ores exported to foreign countries are subject to an export duty of 2 per cent. of the value f.o.b. port of shipment.

FRENCH WEST AFRICA.—For the purpose of assessing export duty, the valuation of rubber exported from April 1st to October 1st has been fixed at 500 francs per 100 kilogs. for shipments from Senegal, French Guinea, Ivory Coast, and Dahomey. Export duty is leviable at the rate of 7 per cent. on the valuation.

BRITISH INDIA.—An official announcement has been issued by the Department of Commerce and Industry that all qualities and sizes of ruby block mica, both of Government and trade descriptions, may be shipped freely to London without any restriction whatever. The British Government, however, reserve the right to requisition any consignments on arrival if required for military munitions.

EAST AFRICA AND UGANDA PROTECTORATES.—The Customs Departments of East Africa and Uganda have been amalgamated, and are now under the control of the Chief of Customs of East Africa. The East Africa Customs Regulations will apply generally to the amalgamated Department. Road and wharfage dues have been abolished by the Government of Uganda.

JAMAICA.—The increased import duties imposed last year on certain goods—see ELECTRICAL REVIEW of August 18th, 1916—have been re-imposed for the year ending March 31st, 1918.

UNITED STATES OF AMERICA.—The War Revenue Bill, as passed by the House of Representatives, provides for an additional Customs duty of 10 per cent. *ad val.* on goods which are dutiable under the United States Tariff Act, and a duty of 10 per cent. *ad val.* on goods which are free of duty under that Act. The measure has yet to be passed by the Senate, who, it is understood, are proposing various amendments.

NETHERLANDS.—Under a recent Customs decision, sheets of mica, even if cut in special sizes, will be admitted free of duty.

GRENADA.—The importation by steamer of electrical apparatus, among other goods, is prohibited by Proclamation, as from May 25th.

NEW PATENTS APPLIED FOR, 1917.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

11,900. "Electric signalling systems for mines." AUTOMATIC TELEPHONE MANUFACTURING Co. & H. GREEN. August 20th.

11,927. "Electric switches." J. M. NAUL. August 20th. (U.S.A., May 10th, 1916.)

11,983. "Electric transforming and converting apparatus." BRITISH THOMSON-HOUSTON Co. (General Electric Co., U.S.A.). August 21st.

11,990. "Means for uniform distribution of current to direct-current units connected parallel." AKT. GES. BROWN, BOVERI ET CIE. August 21st. (Germany, August 21st, 1916.)

11,993. "Ignition dynamos." E. C. R. MARKS & SPLITDORF ELECTRICAL Co. August 21st.

11,996. "Electric ignition apparatus for internal-combustion engines." F. HIRD & H. W. F. IRELAND. August 21st.

12,016. "Telephone systems." AUTOMATIC ELECTRIC Co. & AUTOMATIC TELEPHONE MANUFACTURING Co. August 21st.

12,035. "Switchgear for starting and controlling electric motors." J. A. HIRST. August 22nd.

12,054. "Machine switching telephone systems." WESTERN ELECTRIC Co. August 22nd.

12,074. "Contact devices." IGRANIC ELECTRIC Co. (Cutler-Hammer Manufacturing Co., U.S.A.). August 22nd.

12,077. "Direct-current electric motors." F.I.A.T. FABRICA ITALIANA AUTOMOBILI TORINO SOC. ANON. & J. Y. JOHNSON. August 22nd.

12,104. "Electrical point detectors for railways." A. E. HUDD & G. H. WION. August 23rd.

12,105. "Supports for electric fans, &c." F. C. W. THOMPSON. August 23rd.

12,114. "Cooling appliances or sparking plugs and other details of internal-combustion engine cylinders." J. POMEROY. August 23rd.

12,125. "Ignition apparatus for internal-combustion engines." REMY ELECTRIC Co. & A. E. WHITE. August 23rd.

12,127. "Incandescent electric lampholders." P. M. R. SALLES. August 23rd.

12,129. "Magneto-electric generator." F. L. HOLLISTER. August 23rd.

12,132. "Magnetic compasses." M. B. FIELD. August 23rd.

12,149. "Electric heating, &c., apparatus." H. BURGESS & A. H. TAYLOR. August 24th.

12,158. "Cord grip for electric lampholders." J. P. KAVANAGH & F. H. R. NEVILLE. August 24th. (New Zealand, November 11th, 1916.)

12,165. "Electrically-operated mechanism for driving clockwork trains, &c." F. HOLDEN. August 24th.

12,191. "System for protection of three-phase alternating-current systems." R. J. JENSEN. August 24th.

12,199. "Electric signalling systems for mines, &c." AUTOMATIC TELEPHONE MANUFACTURING Co. & C. REMINGTON. August 25th.

PUBLISHED SPECIFICATIONS.

1916.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

6,517. SYSTEMS OF TELEGRAPHY. C. E. Hay. May 5th, 1916. (108,380.)

10,950. ELECTRIC SWITCHES. G. O. Donovan & W. Donovan. August 3rd, 1916. (108,357.)

10,999. DETECTORS FOR WIRELESS TELEGRAPHY. W. Cross (Svenska Aktiebolaget Gasaccumulator). August 3rd, 1916. (108,361.)

11,348. STARTERS FOR ELECTRIC MOTORS. Switchgear & Cowans and G. H. Neep. August 11th, 1916. (108,366.)

11,972. MINE SIGNALLING KEYS. Sterling Telephone & Electric Co., F. G. Bell & W. C. Davey. August 23rd, 1916. (108,373.)

12,020. METHOD OF PREPARING RADIO-ACTIVE MINERAL WATERS CONTAINING RADIUM-PRECIPITATING ACIDS. August 24th, 1915. (101,295.)

12,091. WIRE-DRAWING MACHINES. R. D. Conner. October 22nd, 1915. (101,963.)

12,441. ELECTRIC MEASURING INSTRUMENTS. British Thomson-Houston Co. (General Electric Co., U.S.A.). September 2nd, 1916. (108,379.)

12,758. "Shoes or sockets for electric cable terminals." W. T. HENLEY'S TELEGRAPH WORKS Co. & W. S. WAKEFIELD. September 8th, 1916. (108,381.)

13,798. THERAPEUTIC ARC LAMPS. F. Forbes & F. W. Collett. September 28th, 1916. (108,392.)

13,954. SIGNALLING APPLIANCES FOR COLLIERIES AND THE LIKE. J. Samson. October 2nd, 1916. (108,397.)

14,930. METHOD AND APPARATUS FOR CONTROLLING ELECTRIC ARCS. D. F. Comstock. October 30th, 1915. (101,886.)

15,007. ELECTRIC MOTOR CONTROLLERS AND LIKE APPARATUS. G. Ellison & J. Anderson. October 21st, 1916. (108,403.)

15,053. ELECTRIC CANDLE FITTINGS. H. Garde. October 23rd, 1916. (108,406.)

16,503. ELECTRIC SIGNALLING LAMPS. H. Lucas & C. L. Breeden. December 27th, 1916. (108,424.)

1917.

1,347. AUTOMATIC TELEPHONE SYSTEMS. Automatic Telephone Manufacturing Co. February 14th, 1916. (104,171.)

1,754. ELECTRIC MOTOR CONTROL AND APPARATUS THEREFOR. British Thomson-Houston Co. & H. C. Hastings. February 3rd, 1917. (108,430.)

4,588. ELECTRODES FOR ELECTRIC ARCS AND FOR MEDICAL AND OTHER PURPOSES. J. C. Round. March 29th, 1917. (108,437.)